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ABSTRACT

This report provides readers with three primary products: significant data on statewide planning for cooperative computing, a process model to evaluate the development of cooperative computing in any state, and a structural model to evaluate the products of implementation in states that have implemented plans for cooperative computing. Such networks offer educators a vehicle both for providing computer services cost effectively and for increasing the level of service, as well as a mechanism for overcoming many of the barriers to interinstitutional resource sharing. A summary of participants in a national survey, and the characteristics of persons interviewed in case studies is included in the first appendix. The second outlines three case studies from the states of Minnesota, New Jersey, and Illinois. Each case study discusses planning, chronology, and strengths and weaknesses. A 31-item bibliography is also included. (Author/JEG)

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Cooperative Computing: A Process Perspective on Planning and Implementation

Richard B. Heydinger
Donald M. Norris

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PREFACE

With this monograph, EDUCOM initiates a series to be published occasionally over the next several years. As EDUCOM develops research projects related to computing and resource sharing, reports will be prepared that are too detailed to be published as articles in the *EDUCOM Bulletin* or other professional journals, but may not be long enough or of sufficient general interest to warrant publication through commercial publishers. An EDUCOM monograph series seems to be the best form for disseminating project results.

Through the EDUCOM monograph series, we hope to share the results of scholarly inquiries directed at problems of immediate importance. Monographs can be published with considerable speed, and at a reasonable cost. Current projects that will result in later monographs include studies of pricing and budgeting of computing services and the provision of user services.

Cooperative Computing: A Process Perspective on Planning and Implementation provides readers with three primary products: significant data on statewide planning for cooperative computing, a process model to evaluate the development of cooperative computing in any state, and a structural model to evaluate the products of implementation in states that have implemented plans for cooperative computing. I believe that readers will find the volume useful and informative.

James C. Emery
EDUCOM President

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The successful completion of this study owes much to the personal and financial support of a number of institutions, colleagues, and friends. We wish to take this opportunity gratefully to acknowledge the special contributions of those individuals and organizations whose assistance was indispensable.

From the very beginning, EDUCOM and its staff have supported our research through advice, assistance, and eventually formal sponsorship. This support furnished the visibility and organizational affiliation that are critical for a study of this type. H. Eugene Kessler, Executive Director and Treasurer of EDUCOM, has been a particularly helpful advocate.

The Horace B. Reckham School of Graduate Studies and the School of Education at The University of Michigan provided financial support for the early stages of our research which was instrumental in the successful completion of the national survey of cooperative computing. Richard Johnson and the EXXON Educational Foundation were sufficiently convinced of the merit of our undertaking to provide support for the research expenses incurred in completing the case studies. The EXXON Foundation also has subsidized the wider dissemination of the published findings. Taken together, these sources of support have enhanced substantially the quality of our data and have broadened the distribution of research findings.

Charles Mosmann merits a special expression of gratitude. His pioneering work in the study of statewide computing systems provided a solid foundation on which our study was grounded. In addition, he

shared with us both his original data and helpful suggestions regarding our research.

The comprehensiveness and quality of our findings were dependent on the willing cooperation of computing managers and educators in all 50 states. Dr. Donald Henderson and the staff of the Minnesota Educational Computing Consortium provided valuable feedback in pilot testing the national survey questionnaire. The respondents who participated in our survey in each of the 50 states deserve a special vote of thanks for undertaking a complex survey instrument and follow-up telephone inquiries with great care and tolerance. Our debt of gratitude is deep to those dozens of individuals in New Jersey, Illinois, and Minnesota who participated in the interviews for our case studies in those three states. Especially worthy contributions were made by those who provided feedback and critique on initial versions of the case studies: Donald Henderson, Dale Lafrenz, and John Haugo in Minnesota; Joseph Denk, John Clark, and Alice Irby in New Jersey; and David Nyman and Michael Sher in Illinois.

In addition to serving as an EDUCOM-sponsored study, our research supported tandem dissertations at The University of Michigan. We appreciate sincerely the willingness of Wade Ellis and the Horace B. Rackham School of Graduate Studies to accept and succor a nontraditional mode of dissertation research. In addition, our appreciation is extended to Marvin W. Peterson, Director of the Center for the Study of Higher Education and our committee chairman, for his guidance and support. James L. Miller, Jr., Gordon Nordby, and Karl L. Zinn also furnished incisive advice and critique as members of our committee.

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January 1977

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CONTENTS

	Preface	i
	Acknowledgments	iii
1.	Factors Influencing the Growth of Statewide Computing	1
2.	The Methodology Underlying This Study	15
3.	A Process Model of the Evolution of Cooperative Computing Organizations	23
4.	Current Trends in Statewide Computing	33
5.	A Structural Model of Cooperative Computing Organizations	59
6.	Some Operational Hypotheses for Implementation	71
7.	Applying the Findings on Statewide Computing Networks	103
	Appendix A. Summary of Participants in National Survey	115
	Appendix B. Case Histories of Statewide Consortia: Minnesota, New Jersey, and Illinois	117
	Bibliography	151

CHAPTER 1

Factors Influencing the Growth of Statewide Computing

The past decade and a half has witnessed massive growth in both academic and administrative computing activities in higher education. Computing facilities and budgets have mushroomed. Computing capabilities have become a new coin of the academic realm, mentioned in the same breath with library, laboratory, and classroom facilities. Moreover, institutions have experienced increasing pressure to utilize fully capacity of existing computers, to trim or hold down increases in computing costs, and to expand the availability of specialized computing resources without duplicating such expensive resources on every campus. Growing regional state colleges and universities, in keeping with their emerging roles, have strongly demanded new computing capabilities. Small institutions, burdened by precarious financial conditions, have sought ways to gain access to computing services without having to purchase their own hardware or to hire their own resource personnel.

Advances in telecommunications technology have made it possible to access and utilize computing facilities from great distances. Using telephone lines, microwave links, or satellite communications, computers can be joined so that a user on one computer may access the processing capabilities of other machines. Similarly, computing software, data bases, and decision algorithms may be accessed via telecommunications. In a sense, therefore, computing has become "space independent." As a result of the growth of educational computing, the pressure for sharing of computing resources, and the capabilities provided by telecommunications, computer networking has developed. In the eyes of their supporters, networks offer educators a vehicle both for providing computing services cost effectively and for increasing the

level of service. Networks also provide a mechanism for overcoming many of the barriers to interinstitutional resource sharing. Some visionaries predict that computer networks will eventually link the instructional, research, and administrative computing capabilities of colleges and universities into a sophisticated, accessible technological resource.

This chapter traces both the development of computer networking in higher education and the factors that have fostered this development. While many of these factors deal with computing and telecommunications issues, a large number relate to the statewide coordination of higher education and the special susceptibility of computer networking to pressures for statewide coordination. In the last half of the chapter data show how the prolific development of statewide computing networks has been largely attributable to these pressures.

THE GROWTH OF EDUCATIONAL COMPUTING AND THE TECHNOLOGY OF NETWORKING

The growth in expenditures and capabilities for educational computing over the past two decades has been phenomenal. Computing expenditures in higher education grew from under fifty million dollars in 1962-1963[1] to an estimated level of over seven hundred million dollars in 1974-75.[2] During this time period, the rate of growth of educational computing expenditures consistently outstripped the rate of increase of educational expenditures in general.[3] Thus, during a time of unparalleled growth in higher education, computing was one of its fastest-growing components.

This growth in expenditures was accompanied by spectacular increases in computing capabilities and speeds, but rapidly diminishing unit costs. During this period, computing in higher education evolved from a high cost, esoteric laboratory device to an economical, convenient aid for a wide variety of academic and administrative activities.

Computing originated and developed in major research universities, and, as one would expect, these institutions continue to spend proportionately more for educational computing.[4] However, almost every in-

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[1] Roger E. Levien, *The Emerging Technology* (New York: McGraw-Hill, 1972) p. 127.

[2] Richard V. deGrasse, *Remote Computing in Higher Education: Prospects for the Future* (Burlington: The University of Vermont, 1971), p. 23.

[3] For example, institutional expenditures for higher education increased by 68.2 percent between 1965-66 and 1969-70, while computing expenditures in higher education increased by 227.1 percent during the same period.

[4] Levien, p. 147.

stitution uses some form of data processing equipment, and state appropriating agencies have been confronted with demands for computing capabilities from all types of institutions. An especially nettlesome problem has been presented by the metamorphosis of state colleges into regional state universities. As these institutions have grown in size and broadened their mission, research-oriented faculty and entrepreneurial presidents have pressed for sophisticated computing capabilities. Thus, most states have been confronted with demands for across-the-board increases in data processing capabilities and legitimate demands for access to sophisticated computing capabilities from almost all four-year institutions, not just the one or two major research universities. To the extent that states were slow to meet these demands, state college faculty and administrators expressed a sense of inequity and thwarted aspirations.

While increased speed and decreasing unit costs have enhanced the desirability of educational computing, other technological developments have proven significant in improving computing's "transmittability." First, computing peripherals have consistently improved. Today's portable terminals allow the user to take computing to wherever there is a telephone extension. Significant developments have also taken place in the field of telecommunications. A substantial portion of today's telephone-line traffic is composed of data bits rather than voice communications. As data traffic has increased, telecommunications firms have established their own national microwave networks. These networks will be used almost exclusively for data transmission. Communication satellites also provide fast, reliable international data communication.

In the near future, "packet-switching" communication networks could again revolutionize computing. Rather than establishing a point-to-point link which consumes an entire communications line, packet switching allows many messages to be sent over the same line. These information packets are then routed to the appropriate receiver. This new technology will send communication costs plummeting, for new users will pay only for the amount of time they occupy a line. Such a change in rate structures, although it may be years away, could literally tie the world together into an instantaneous and economical communications network.

The Development of Cooperative Computing

The demands and the capabilities of networking have encouraged the growth of cooperative computing in higher education. Growth in computing capabilities and overall computing expenditure led to the search

for cost-effective alternatives to every campus purchasing or leasing its own computing resources. Demands for computing access from "have-not" institutions have accelerated the search. Technological gains have increased central processing capabilities. Input/output and telecommunications advances have increased transmittability and have made networking feasible.

Modes of Interinstitutional Computer Activity

To date, interinstitutional computer activities have taken on three distinct modes. The first mode, defined simply as *access*, has been *unidirectional* in format. Large universities discovered that their new, supercomputers had some idle or unused capacity. If this capacity could be used by off-campus customers, the marketing of the resource would bring real revenue to the institution to offset the tremendous lease (or purchase) costs of the hardware. Simultaneously, smaller colleges that did not possess any computing resources and the emerging state universities with inadequate facilities were feeling pressure from their faculty and students for computer access. Thus, a natural market for educational computing was created and resulted in the smaller "have-not" institutions entering into an agreement whereby they could access the computing resource at a nearby university. Examples of this type of sharing were numerous throughout the country. This access may have been simply permission to utilize the computer center as any on-campus user would or may have been an actual communications link. In this way, the smaller institution accessed the computer at another institution without a reciprocal arrangement. The larger university simply offered a service for which it received money, with no gain in its computing power or technical assistance.

The second mode of cooperation arose as institutions were contemplating the purchase or lease of a computer. A joint purchase with another college or university was an attractive, economical alternative. This type of cooperation, however, was fraught with a complexity of details that could lead to the breakdown of negotiations between institutions. Many questions had to be answered, and a working compromise was an absolute necessity. For example, on which campus would the machine be located or would it be housed at a "neutral" site? Whose staff would operate the machine? Although obstacles were often insurmountable, some institutions were able to solve these problems and to jointly purchase a single machine. The most prominent example in existence today is the Triangle Universities Computing Center, established in 1964 and placed in Research Triangle Park, which is located equidistant from Duke, North Carolina State, and the University of North Carolina. This second mode of cooperation represents a multi-

directional linking and is designated *"single-facility sharing."* The most salient characteristic of single facility sharing is reciprocity. Each institutional party not only contributes to the computing resource but draws on it as well.

The third mode of cooperation has characteristically involved large universities that already possessed sizable computer installations. Such institutions viewed neighboring universities and computing facilities as potential instruments for the enrichment of their computing power. With a communications link, some additional hardware, and a substantial programming effort, the computers on each of these campuses could be joined together to form a multicomputer network. Computer-to-computer networks could expand the capacity of each campus and significantly increase the software resources available. The MERIT computer network, which joins the computers of the University of Michigan, Wayne State University, and Michigan State University into a single-computer resource, is such a network. This mode of cooperation is termed *"distributed network sharing"* and represents only a small percentage of today's cooperative activities. Although such networks are technologically possible, few universities have solved the organizational, political, and economic problems of operating a multicomputer network. Nevertheless, this remains as a significant alternative for cooperative activities, and one that will undoubtedly increase over time.

In contrast to the access mode, which is defined as unidirectional sharing, the latter two modes of cooperative activities are defined as *multidirectional* sharing. All parties involved in multidirectional sharing act as both suppliers and consumers of computing resources, thus creating an interdependency that may not exist in unidirectional sharing.

Types of Networks

The list of ongoing networking ventures involving educational computing is extensive and growing. A simple review of the literature on networking reveals that some form of major educational computer network exists in at least eighteen states. The diversification of these networks is illustrated by the following examples. ARPANET, an international *facilitating/communications* network, links the major research computers of a number of large universities and laboratories in the United States. ARPANET provides the communication link that enables the processing of computing tasks on a wide selection of specialized machines. A variety of *disciplinary* networks have been created to provide special services to users in different academic disciplines. In some cases these networks provide actual hardware linkages, while in

other instances they furnish only discipline oriented facilitating services. The National Center for Atmospheric Research (NCAR) is the hub of a national discipline oriented network that serves atmospheric researchers. Library nets have also been developed. Probably the most well known is the Ohio College Library Center (OCLC) whose services have also been replicated at the University of Toronto and distributed by regional nets like the New England Library Network (NELINET). The Interinstitutional Consortium for Political Research (ICPR) provides political scientists from 170 participating institutions with access to information bases and special software programs.

There are also a number of general purpose *regional* networks. The New England Regional Computing Program (NERComP) aids educational institutions in the Northeast by providing access to computing facilities at a number of New England colleges and universities. By 1973, the National Science Foundation had sponsored twenty-eight regional computer networks through its Regional Cooperative Computing Activities Program. Prominent examples were located at the University of Iowa, Oregon State University, and the University of Texas at Austin.[5] In most of these networks, smaller institutions accessed one of the major educational facilities in the state, and sharing was unidirectional. Finally, a significant number of states have created *statewide* educational computing networks. These networks, and their planning and implementation, are the focus for this study.

SPECIAL FORCES ENCOURAGING THE GROWTH OF STATEWIDE NETWORKS

A number of factors have facilitated the rapid development of statewide computing networks. The period of the greatest growth of educational computing was paralleled by increasingly active interventions of state government and coordinating agencies in higher education. First, this intervention both encouraged and sustained the growth of statewide networking. Second, computing proved to be more susceptible to the interventions of statewide coordinating agencies than were some other higher education policy areas. Third, statewide computing networks in education were patterned after already existing models of regional networking and of networking among noneducational government agencies, exclusive of education. These models were easily adapted to statewide educational networking. Thus it is necessary to re-

[5] Fred W. Weingarten, et al., *A Study of Regional Computer Networks* (Iowa City: University of Iowa, February 1973), pp. 242-52.

view the growth of statewide coordination in order to understand the development of statewide computing networks.

THE GROWTH OF STATEWIDE COORDINATION OF HIGHER EDUCATION

Over the past two decades, educational institutions have been subjected to increasingly vigorous coordination from a variety of state-level boards. These boards have included voluntary associations of institutional representatives, coordinating boards with institutional or public memberships, and consolidated governing boards, composed of public members having regulatory powers over educational institutions. Over the course of the past twenty years, there has been a progressive shift toward "more powerful" structural forms of coordinating boards. For example, voluntary associations have been replaced by coordinating boards with advisory powers, which have in turn been replaced by coordinating boards with regulatory powers.

At the same time, the statutory powers of these coordinating and governing boards have been increased. Budget review, new and old program review, and statewide planning now fall under the purview of many of these agencies. As their structural forms became more powerful and as their statutory powers increased, many coordinating/governing boards expanded their realm of review activities, including budgetary supervision of computing operations and hardware expenditures. Indeed, the involvement of these agencies in the review of computing has been especially heavy, reinforced in part by the particular susceptibility of computing to the pressures exerted by statewide coordination.

Susceptibility of Educational Computing to Statewide Coordination

Even with the increased influence of statewide coordination, it might have been possible for educational computing to have escaped the pressures for cooperation. If educational computing possessed some of the characteristics of more-traditional academic resources, the pressures for cooperation would have been considerably less. But educational computing is vulnerable because of: 1) its visibility and its natural tendency to grow, 2) the legitimate demands for increased access to computing, 3) the congruence between the goals of statewide coordination and the potential rewards of cooperation involving educational computing, 4) the applicability of the methods of statewide coordination to cooperative computing, 5) the ease of resource sharing involving computing.

Growth and Visibility of Computing. The increase in computing expenditures in higher education over the past fifteen years was dramatic, even when considered in proportion to the parallel increase of total higher educational expenditures. Equally important, computing expenditures could generally be identified and separated from other academic expenditures. Major hardware acquisitions were often treated as capital expenditures and were subjected to special review processes. Both of these factors directed attention to computing in higher education.

Demand for Increased Access to Computing. In an age when scientific information doubles in decades rather than centuries, and knowledge of computing is important to every functioning adult, tremendous pressure exists to make equal access to computing a right, not a privilege. In Minnesota and Alberta, for example, the right of young people to equal access to computing, regardless of where they live in the state or province, is a consciously stated objective of public policy.

Yet, throughout the sixties and even today, many institutions and/or students have not had access to the computing resources necessary to fulfill their educational objectives. In 1969, John W. Hamblen[6] estimated that over half of the nation's colleges and universities lacked computer facilities and that over one million students in these institutions lacked access to computing. This inequality was exacerbated by inequalities in the distribution of outside computer support. Between 1964 and 1969 the relative level of industry support for computing in higher education declined, even though industry's dollar contribution remained constant. As a result the absolute amount and relative share of federal and institutional funds (often state-appropriated) for support of computing rose. While all institutions were pressed, smaller institutions with limited access to federal funds were especially disadvantaged.

Although most of the have nots reflected in the Hamblen data are private or small public institutions, other sources of inequality existed in the sixties and still exist today. The computing in emerging state universities was often inadequate to their developing roles and almost always inadequate to their aspirations. Regional state colleges and universities, especially those with new and growing graduate offerings, confronted legislatures with constant and increasing demands for greater computing facilities or the access to such facilities.

Finally, the demand for greater access to computing was increased by expanding administrative computing applications. As statewide coor-

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[6] John W. Hamblen, *Inventory of Computers in U.S. Higher Education 1960-70: Utilization and Related Degree Programs* (Washington, D.C.: U.S. Government Printing Office, 1972), p. 5.

dinating agencies and state government increased their demands for management information, administrative computing grew, both in amount and in complexity. The increasing use by administrators of modeling and other analytical techniques has greatly diminished the once-considerable distinction between administrative and academic computing.

Goal Congruence. There is a high level of congruence between many of the goals and expectations of statewide coordination and the potential outcomes of cooperative computing. Statewide coordination's goals of fostering efficiency and holding down costs conform nicely with cooperative computing's promise to expand computing services cost effectively without placing a computer on every campus. Statewide coordination aims to establish a reasonable level of public control over institutional development and to reduce what is known pejoratively as "academic nationalism." Cooperative computing aims to "rationalize" the development of the educational computing system by designating some institutions as "vendors" or "brokers" and others as "users." Finally, the objective of state coordination to aid private education within constitutional limits is serviced nicely by cooperative computing's potential to share computing resources among both public and private colleges.

Applicability of the Methods of Statewide Coordination. Another cause of the susceptibility of cooperative computing to the pressures of statewide coordination is the applicability of mechanisms utilized by statewide coordination in effecting its goals to educational computing. First, the foci of power for both entities are the same. The review of hardware acquisition is similar to capital expenditure review, and computing operating budgets pass through the normal appropriation review process, although with greater visibility. Second, a number of the types of "intervention" used in statewide coordination have proven successful in encouraging the growth of cooperative computing. Successful intervention strategies included a general freeze of computing operating budgets, a general moratorium on new hardware acquisitions, disapprovals of specific institutional budget and/or hardware requests, or directives to plan or share.

The Ease of Resource Sharing Involving Computing. Even without technological constraints, computer networking in education could be impeded by the same sorts of organizational/political difficulties that render inoperative most plans for sharing academic resource sharing schemes. Yet while these constraints exist, they are far less debilitating than those that beset traditional academic resources. There are several reasons for the differences.

First, computing is naturally unstable. New hardware and software

technologies appear frequently and must be accommodated. In this sense, computing serves as a potent change agent. Second, computing expenditures, not just hardware facilities, are the critical resource. Computing managers understand that they can increase their real resources through cooperative computing without actually purchasing or leasing equipment themselves. Finally, the computing users often become acquainted with computing capabilities on other campuses and want similar capabilities for their own campuses. Cooperative computing is often the only means of achieving this end.

THE GROWTH OF STATEWIDE COMPUTING

Advances in computing technology, telecommunications, and different types of networking have coupled with pressures for statewide coordination to support the rapid growth of statewide computing. In most states the question has become not, "whether to share educational computing," but rather, "how much, where, and when." At the same time, statewide computing cooperation has become a topic for research and study. Two survey based studies have provided insight into the growth of statewide educational computing: the NASIS[7] 1974 annual survey of state data processing administration; and an EDUCOM sponsored survey of statewide computing cooperation for higher education that was conducted by Charles Mosmann in 1973-4.[8] Although the NASIS study focused on computing cooperation in all state government agencies, a segment of the questionnaire attempted to assess whether state government oversight of computing was being applied to higher education in addition to state agencies. This study presented information which implied that a significant level of state coordination existed for higher education computing.

The second study, conducted by Dr. Charles Mosmann under EDUCOM sponsorship, also demonstrated the growth of statewide educational computing. Mosmann showed that twenty-seven states had experienced some form of review of computing decisions by a higher authority (a coordinating or consolidated governing board, or some form of state government agency). Also, these data showed that forty-one states had participated in either statewide or interstate cooperation

[7] National Association of State Information Systems (NASIS), *Information Systems Technology in State Government* (Lexington, KY.: Council of State Governments, 1974), pp. 19-22.

[8] Charles Mosmann, *Statewide Computing Systems* (New York: Marcel Dekker, 1974).

for educational computing.

If the Mosmann data is manipulated according to the "access" and "multi-directional sharing" dichotomy discussed earlier in this chapter, the extent and variety of cooperative computing relationship can be shown. Table 1.1 presents these data.

TABLE 1.1

States Engaged in Access and Bidirectional Sharing
N=50

	Access	Multidirectional Sharing
Yes	33	7
Under Development	4	11
No	13	32

Source: Reinterpretation of Mosmann data

From this table, it is clear that access has been the predominant form of cooperation. Thirty-three states chose access style sharing as opposed to seven states that selected multi-directional sharing. Undoubtedly this pattern of choices reflects the greater difficulty involved in undertaking the reciprocal relationships of multi-directional sharing and the relative ease of simple access. However, a significant number of states had multi-directional sharing arrangements under development.

Table 1.2 probes more deeply into the nature of the cooperative ventures in those states that had engaged in access or multidirectional sharing. The first dimension examined is the "jurisdiction" of the sharing; whether the sharing occurred among similar types of institutions, cut across the boundaries of different systems of institutions, or both. The second dimension examined is the nature of the computing resources which were shared via the cooperative activity. Interestingly, the majority of the access arrangements involved both academic and administrative computing, most often in the same computing system. On the other hand, for multidirectional computing, academic computing was the resource most often shared.

THE DETERMINANTS OF COOPERATIVE COMPUTING

The question of whether certain types of computing coordination and statewide planning are conducive to the existence of cooperative

TABLE 1.2

Jurisdiction and Resources Shared in States Engaging in Access or Bidirectional Sharing

	Access N=33	Bidirectional Sharing N=7
Jurisdiction		
Within system of institutions	19	3
Between system of institutions	11	4
Both	2	0
Insufficient Information	1	0
Resources Shared		
Academic computing only	2	4
Administrative only	4	0
Both, same computing system	16	2
Both, different computing system	8	1
Mixed	2	0
Insufficient information	1	0

Source: Reinterpretation of Mosmann data

activities was not directly addressed by the Mosmann analysis. However, additional interpretation of the data suggests several provocative relationships.[9]

For example, it appears that states with *consolidated governing* boards were slightly more likely to have completed statewide computing plans. Also, states with this form of educational coordination were far more likely to have actually implemented a statewide plan. However, states with *coordinating* boards were far more likely to have statewide plans "under development;" it remains to be seen whether the apparently greater propensity of governing boards to encourage

[9] A more detailed interpretation of the Mosmann data may be found in: Donald M. Norris, "The Planning of Statewide Cooperation Involving Educational Computing," (Ph.D. dissertation, The University of Michigan, 1976), pp. 62-68.

statewide planning was only a temporary advantage.

There do not appear to have been any relationships between the form of educational coordination or the form of computing coordination and the likelihood of sharing academic computing resources. Institutions shared academic computing resources about equally, regardless of the form of coordination. On the other hand, administrative computing resources were far more likely to have been shared in states where a state office reviewed computing requests on the basis of needs and cost or on the basis of a statewide computing plan.

The form of computing coordination appears to have influenced the choice between access and multidirectional sharing. States in which institutions make their own computing decisions were less likely to have access cooperation and were more likely to have engaged in multidirectional sharing. Although it was not very common, multidirectional sharing was more likely in states where institutions made their own computing decisions and had the capacity to make the difficult decisions necessary to actually pool resources.

CONCLUSIONS AND THE NEED FOR FURTHER RESEARCH

Both the NASIS and Mosmann surveys are valuable pieces of research that provide usable input for decision makers dealing with computing. The NASIS survey provides a yearly updated appraisal of coordination and control of computing, information systems development, hardware capabilities, and related activities pertaining both to state government agencies, and, to a lesser extent, to higher education. The data are especially helpful to state agency personnel and are cast in terminology and classifications reflecting their perspective.

The Mosmann data provides an excellent description of cooperative computing in the American states and Canadian provinces. It focuses attention on the potential importance of planning and the underlying characteristics of the state that may influence the computing environment. This survey was a timely piece of exploratory research that revealed to both computing managers and to educators the growing importance of cooperative computing (much of which is planned).

However, much remains to be done to expand our knowledge of cooperative computing. The need for improved data on the coordination of computing has already been discussed. It is also necessary to know more about the particulars of the planning and implementation processes. The Mosmann study did not provide any such details. For example, the level of cooperation prior to statewide planning was not identified. Nor were the different forms and participation patterns of

the planning process discussed. The contents of the state plans were not revealed. The nature of the organizational structures created to oversee cooperation were not explored extensively. Therefore, it is impossible to adequately infer cause and effect from the Mosmann survey largely due to the lack of chronology that would help to explain important planning and implementation activities. Furthermore, we do not know the nature and characteristics of the various interventions by which cooperation, planning, and implementation are caused. By considering these elements, it may be possible to specify cause-and-effect relationships with greater accuracy and confidence.

It is necessary to understand more fully the process by which states plan for cooperative computing and implement computing plans and cooperative arrangements. Also, we need to comprehend the structures created to administer cooperative computing. Such understandings will provide a firmer grasp of the organizational and political dimensions of cooperative computing. These are the dimensions that have been recognized as the most important and significant barriers to cooperation. The research undertaken by this study explores these processes and structures.

CHAPTER 2

The Methodology Underlying This Study

This research project was completed in three distinct phases: 1) problem formulation and review of existing data, 2) a national survey of the planning and implementation of cooperative computing, and 3) a detailed examination of the operational experiences of three states. This chapter discusses the rationale and methodology of each phase separately.

PHASE I: PROBLEM FORMULATION AND REVIEW OF EXISTING DATA

This project began with an extended period of time devoted to defining the nature and scope of the study. Three objectives were outlined for this phase: 1) to characterize and classify cooperative computing in each state, 2) to determine what types of information were lacking, and finally 3) to outline the boundaries of the research problem. In this review phase four data sources proved useful. The questionnaire data from the Mosmann study was given over to us in its entirety. Dr. Mosmann graciously supplemented this with audio tapes of his own insights and bibliographies. Second, data from the *N*ational *A*ssociation of *S*tate *I*nformation *S*ystems (NASIS) provided state-by-state characterizations of the proliferation of computing in state government. Third,

we reexamined generally available data on state coordination.[10] Finally, we filled in the gaps with personal files on computing and networking.

From these data a detailed taxonomy was created which characterized each of the 50 states. Although this taxonomy did promote comparison of the states, it also highlighted the needs for additional information. It was at this point that a theory of the *process* of cooperative computing began to emerge.

Next we conducted a brief review of the existing literature on computer networking, state coordination, interorganizational theory, the theory of consortia, and the diffusion of innovations. After these concepts were reviewed in light of the fifty-state taxonomy, a model of the iterative process of cooperative computing was proposed and refined. This model (See Chapter 3) guided the design of the national survey.

PHASE II: THE NATIONAL SURVEY OF COOPERATIVE COMPUTING

Two survey instruments were designed for the national data collection; one to be sent to the states that had completed statewide planning or were in the process of developing such a plan, and a shorter survey to be sent to the states that had not planned. The longer instrument (planning questionnaire) focused on the most recent statewide planning process and asked a series of questions that probed previous planning and sharing activities, characteristics of the state, how the most recent planning process began, characteristics of the statewide computer planning process, the characteristics of the statewide computer plan, the means by which the plan was approved, and the implementation of the plan. The shorter instrument for states that had not planned assessed any planning and sharing activities that had transpired, and any attempts to start statewide planning that had failed.

After initial design of the planning questionnaire, it was mailed to eight people in the state of Minnesota as a pre-test. This mailing was followed by a site visit to discuss the questionnaire and its shortcomings. This pre-test demonstrated that "factual" information could be collected successfully by distributing questionnaires to a few key people in each state.

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[10] See particularly: Robert O. Berdahl, *Statewide Coordination of Higher Education,* (Washington, D.C.: American Council on Education), 1971; and M. M. Chambers, *Higher Education in the Fifty States,* (Danville, Illinois: Interstate Printer and Publishers, Inc.), 1970.

To be successful, this strategy required a high response rate on a questionnaire that required approximately one hour to complete. Hence, each questionnaire was preceded by a "letter of introduction." This was followed by a phone call to answer any questions, seek participation, and, most importantly, establish rapport with the respondents. Only after agreement to participate were survey instruments sent to the participants.

After allowing several weeks for completion of the questionnaires, follow-up telephone calls were used to encourage return of the surveys. Initially, nearly fifty percent of the questionnaires were received and the first follow-up provided another fifteen percent. After several more weeks had passed, another series of telephone calls was used to reach the participants, especially those in states from which no response had been received. The individuals were either encouraged to complete and return the questionnaire or were asked the questions over the telephone. By the time the process was completed, responses had been received from 85 percent of the participants and information had been collected on all fifty states.

As the questionnaires from a state were returned, they were compared with each other and, where possible, a single characterization of the state was constructed. For cases in which individual responses from one state differed, inconsistencies were reconciled through review of the actual statewide plans or other documentation from the states, follow-up telephone conversations, and personal judgment. Follow-up communication was also used, where necessary, to flesh out incomplete responses to some questions. In total, one-hundred and two people participated in the national survey including fifty-four responses from state government officials and forty-eight from institutions of higher education (See Appendix A for detailed breakdown of responses).

After a characterization of each state had been compiled, descriptive statistics were run. Findings from the national survey, and later from the case studies, were combined to demonstrate the processes through which states had created cooperative computing arrangements. In the simplest sense this meant developing a description of how the states approached each stage of the cooperative process. More significantly, the relationships between different stages in the cooperative process were explored in order to reveal if different structures and processes lead to different planning and cooperative outcomes. Chi-square statistics and creative combination of data from the national survey were used in this analysis. Also, subjective evaluation of the findings from the case studies was used to yield additional insights into the cooperative process and the relationships between the stages. Chapter 3 of this monograph presents the process model that served as a framework for

exploring these relationships, and Chapter 4 reports the associated findings.

PHASE III: THE IMPLEMENTATION EXPERIENCES OF THREE COMPUTING CONSORTIA

Although the national survey provided a good overview of the cooperative computing process, it did not offer detailed information on the states' experiences in attempting to implement the plans. On-site visits which would trace these experiences seemed the best method for collecting this information. Thus we set out to select a limited number of states to visit.

Although many criteria were debated for the selection of case study states, the following reasons dominated our thinking. The most ambitious form of statewide computing was the independent corporation formed specifically to provide educational computing. In most states the not-for-profit independent corporation was the first and only legally constituted consortium of public institutions. It also represented the second most numerous implementation structure among the variety of forms that have been established (See Table 4.5 in Chapter 4). Also, by selecting a single type of implementing organization it would be possible to explore differences among organizations with similar structure. Finally, it was the authors' contention that the statewide consortium represented an important development for all of post-secondary education. If these consortia were successful in attaining their intended purposes, these models might be used to facilitate other types of resource sharing. Thus, we concluded that the independent statewide consortium was an important alternative to study.

At the time of the study five states had approved the establishment of an independent corporation to provide statewide computing. These states were: Washington, North Carolina, New Jersey, Illinois, and Minnesota.[11] Washington was immediately eliminated because, at the time, it was only in the planning stage. North Carolina is the oldest and most publicized state consortium, yet it emerged from a cooperation among the state's three major universities rather than through direct intervention by the state government. New Jersey, Illinois, and Minnesota all had experienced sequences of intervention, planning, and implementation. Moreover, all of them had some history of implementation activi-

[11] Although MECC (Minnesota) is not technically a corporation, formation under the Joint Powers Act provides it with most of the same freedoms.

ties. Yet within the consortium framework they also represented three distinct approaches. Finally, although we were to concentrate on the independent consortium, we wanted a range of characteristics and experiences which would encompass the scope of higher education. Thus, New Jersey, Illinois, and Minnesota were selected for in-depth case studies and site visits.

The primary purpose of the case studies was to gain an understanding of the process of implementing a statewide computing organization. From our design work it became evident that a model was needed to classify and categorize network organizations. Thus a generalized structural model was drafted (See Chapter 5). This model became the framework for analyzing the data collected in these case studies (See Chapter 6).

To collect the case study data, three-day site visits were arranged with each computing consortium. All data was collected through individual, structured interviews. Since different constituencies would possess different perspectives on cooperative computing, three interviews were designed. A "planning-implementation" interview traced details of the entire cooperative computing process from its origination to the present. It was administered only to those individuals who had the knowledge and experience of the entire process. A second interview was designed for "institutional users" of the consortium; it focused on current operation of the network. A third interview was aimed at non-educational "state government" representatives; it examined cooperative computing from a state's perspective.

Three brief survey instruments were also included as part of each interview. They focused on influence on the planning process, influence on policy decisions, and the importance of network goals. The first two instruments asked respondents to rate the influence which selected constituencies exerted on the planning process and the policy decisions of the network (See Table 6.2 for a summary of these data).

The goals survey consisted of twenty-three goal statements written by the authors. To produce these goals, a literature review was conducted which focused exclusively on the stated purposes and objectives for cooperative computing. From this emerged five types of network goals: financial, computing service, planning-coordination, autonomy, and governance. For each goal type, a series of goal statements was written which detailed the objectives associated with that goal area. These statements were refined and redundancies were eliminated. The resulting twenty-three goals were then randomized and the survey instrument was constructed. Except for change in network name (i.e., MECC, IEC, NJECN), the instrument was identical for all states (See Tables 6.3 and 6.4).

The sample of persons to be interviewed was arranged after discussions with representatives in the case study state. Each sample encompassed all relevant constituencies including both proponents and opponents of the network. In selecting the samples we relied largely on the cooperation of the state and the effort which network officials were able to devote to arranging interview schedules. Thus, the size and range of the sample varied significantly from state to state (See Appendix A for a summary of the people interviewed).

Data collection was limited by the funds and the human resources available to conduct the case studies. "Covering a state" in three days and interviewing all relevant parties was an impossible task. Nevertheless, after three days of intense interviewing, information became redundant and it was unusual to collect a significantly different opinion. Thus, although these data collection efforts may not indicate the percentage of people who regard an issue a particular way, they do represent most perspectives on each issue. In total, sixty-seven people were interviewed across Minnesota, New Jersey, and Illinois.

Analysis of the interview data was conducted in two steps. First, a detailed chronology of each state was prepared. Then a copy of our preliminary findings was sent to knowledgeable individual(s) in the state for comment and correction, and these corrections were then incorporated into the final case study reports (See Appendix B). This proved to be invaluable, and the authors appreciated the feedback which was received.[12] Second, all interview responses were grouped according to issue or questionnaire item. Due to the small number of interviews from each constituency, responses were not coded. Instead, verbatim transcripts were used to ferret out important issues and points of view. From this analysis the fifteen operational hypotheses (See Chapter 6) were constructed.

SOME AFTER-THOUGHTS ON METHODOLOGY

No methodology is free of problems, and in retrospect, one sees improved ways of conducting a study. If this project were to be repeated, the design should be altered to include two visits to each state: the first visit to collect data on the chronology of events; and the second to focus exclusively on critical decisions. When aggregated the data from

[12] Thanks to John Clark (New Jersey), Joseph Denk (New Jersey), John Hango (Minnesota), Alice Irby (New Jersey), Dale LaFrenz (Minnesota), David Nyman (Illinois), and Michael Sher (Illinois).

the two visits would provide a more complete picture of the state's experiences.

This study also suffered from the lack of implementation experiences in each state. Since the consortia were at the initial stage of implementation, whether it was their first, second or third attempt, there was no steady state to examine retrospectively.

Finally, the findings in this study are influenced by the sample of individuals interviewed. A study of this magnitude and scope required a structured sample of knowledgeable individuals. Detailed instructions on how to select the sample were sent to each state, but the ultimate power of selection was out of the hands of the research team. Moreover, time and financial resources dictated that no more than twenty-seven people in one state could be interviewed. In the future, sample selection should be controlled by the research team and a larger number of individuals should be interviewed and/or surveyed in each state. Perhaps a combination of personal interviews with the primary actors and a mail survey to others would be the best alternative.

This research was intended to be exploratory. With that in mind, the methodology served its purposes well. As the following chapters show, this project made progress in delineating the important parameters of cooperative computing.

CHAPTER 3

A Process Model of the Evolution of Cooperative Computing Organizations

In the past, technological feasibility and the technical particulars of the final sharing arrangements have been the primary focus of computer managers and educators who have shown interest in computing cooperation. Given this orientation, the large number of possible combinations of hardware and software, and the wide variety of differing political characteristics, each state has been perceived as having a unique computing environment. However, as computer managers and educators have begun to recognize the importance of organizational/political barriers to the establishment of cooperative activities, the relative domination of technical considerations has diminished. Key to an organizational/political perspective is focusing both on the *process* by which cooperative arrangements are created and the *networking products* which ultimately develop.

This chapter develops a process model of cooperative activities involving computing. The model brings together concepts pertaining to a variety of diverse organizational topics including interinstitutional decision making and cooperation, planning, and statewide coordination of postsecondary education. Through the general description of the process model the reader can identify the similarities and differences in the evolution of different forms of cooperative computing including statewide, regional, disciplinary, and facilitating networks. When the model is applied specifically to the creation of statewide computing networks, the stages of the statewide cooperative process are detailed. This model of the statewide process also serves as the organizational framework for the research findings reported in the next chapter.

THE EVOLUTION OF COOPERATIVE COMPUTING NETWORKS

A basic premise of the process model is that the establishment of computing cooperation is a form of innovation diffusion. The innovations involved are both technological and organizational; they include both the utilization and acceptance of new technical means of performing computing and the crossing of established organizational and jurisdictional boundaries to do so. The innovation process is viewed as an ongoing, repetitive activity. At any point in time, a state may have gone through any number of iterations of the process, or may be located at any particular stage of the model. Also, different educational institutions within the state may be located at different stages of the model. Similarly, a number of cooperative ventures may be occurring in a state at a particular time, quite possibly independently.[13]

The five stages of the cooperative model are:

1) performance gap assessment (the perception of a need for better computing services);
2) intervention or action to address the perceived need;
3) direct cooperation without extensive planning; or
4) a formal planning cycle (a planning process, a formal plan, approval of the plan, and implementation of the plan); followed by
5) the impact of planned or unplanned cooperation on the computing environment in question.

An unsatisfactory impact or incomplete solution to the performance gap can lead eventually to another repetition of the cycle. All of these elements operate under the influence of the particular characteristics of the jurisdiction whether it is a state, region, or discipline.

There are many differences between the membership characteristics, organizational structure, and operational services of different types of networking. Many of these differences will be discussed in Chapters 5 and 6. These differences are also reflected in the processes by which networking arrangements are established, as Table 3.1 reveals. In general, statewide, regional, disciplinary, and facilitating networks are created to address different forms of performance gaps. The perception

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[13] The conception of innovation diffusion as an iterative process adaptable to a variety of disciplines and fields has been modified from the following sources: Ronald G. Havelock, *Planning for Innovations Through Dissemination and Utilization of Knowledge* (Ann Arbor: Center for Research on the Utilization of Scientific Knowledge (CRUSK), 1971); Everett M. Rogers and F. Floyd Shoemaker, *Communication of Innovations* (New York: The Free Press, 1971).

TABLE 3.1

Differences in the Cooperative Process for Different Types of Computing Networking Arrangements

Types of Networking Arrangements	Stages in the Cooperative Process		
	Performance Gap Assessment	Intervention	Planning Process and the Plan
Statewide	Made by institutions, or more likely, by state agencies or legislature.	Mandate to plan and share comes from parties external to institutions. Moratorium on new hardware acquisitions, computing budget freezes, disapproval of requests.	Planning may involve just the institutions. More often, however, it includes representatives from state coordinating agencies, state computing agencies, consultant firms, industry.
Regional (NERComP, UNI-COLL)	Generally made by institutions or some outside funding group.	Joining together of interested users and a broker with excess capacity. Outside funding source for seed money or equipment.	Voluntary planning. Revolves around specific sharing arrangements and involves the institutions involved and perhaps the funding source.
Disciplinary (NCAR, ICPR)	Individual users or some user organization.	Joining together of interested users and/or central organization. External funding may be used.	Voluntary planning involving users, central disciplinary organization, possibly funding source.
Transmission and Facilitating (ARPANET, Bell Telephone, TYMNET)	Made by individual potential supplier stimulated by a profit motive.	Create new system using outside funding. Utilize existing company system which is expanded to cover new markets.	Unilateral planning but with an eye to the needs of users.

of the performance gap is made by different parties holding different values, expectations, and powers. The forms of intervention utilized to initiate cooperation may vary as well. The type of planning may differ, as may the form of sharing. Statewide cooperative activities reflect the more active involvement of state government and coordinative agencies in the performance gap assessment, intervention, and planning processes. In addition, the diverse roles in different states of state coordinating agencies, state data processing and fiscal agencies, legislatures and governors, cause statewide cooperative activities to be characterized by greater variety than that experienced by other networks.

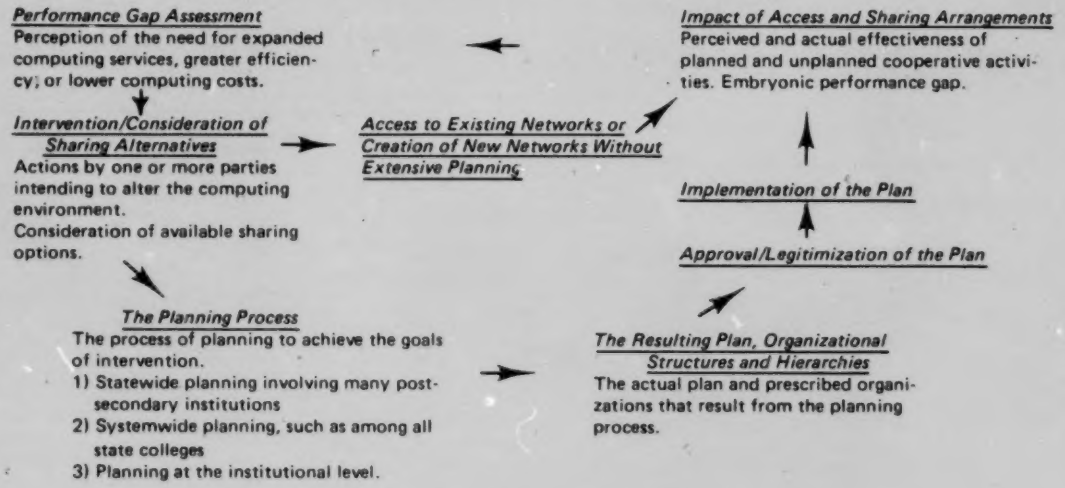
Equally important as the differences between these forms of networking, however, are the similarities between the cooperative processes in each case. The process model is composed of comparable stages. By viewing the cooperative process in this manner, one can comprehend both the similarities and differences between statewide cooperation and other forms of computing cooperation. The model also permits a finer resolution of the differences and similarities between statewide cooperation in different states. In the following discussion we adapt the general process model to the statewide cooperative process and provide a more-detailed explanation of each stage in the process of statewide computing cooperation.

A PROCESS MODEL FOR STATEWIDE COMPUTING COOPERATION

As one examines the interacting relationships among different stages of the process model (illustrated in Figure 3.2) it is important to note that, at every stage in the cooperative process, the characteristics of the state's educational and computing environment exert an important influence. (Chapter 1 discussed how statewide educational pressures have influenced cooperative computing.) The salient elements in a state's educational environment are the numbers and types of institutions and existing cooperative and planning activities dealing with academic resources other than computing.

Elements of the computing environment are the system characteristics that have the greatest direct impact on educational computing cooperation. The most important element of this environment is the state-level mechanism for coordinating or reviewing computing decisions. Other elements include previous computing planning and sharing activities (among educational institutions and among state agencies) and the existing hardware and software capabilities of educational institutions. The major results of computing cooperation are changes in the state's educational computing environment.

FIGURE 3.2. A Process Model for Statewide Cooperative Computing


Performance Gap Assessment
Perception of the need for expanded computing services, greater efficiency, or lower computing costs.
Impact of Access and Sharing Arrangements
Perceived and actual effectiveness of planned and unplanned cooperative activities. Embryonic performance gap.
Intervention/Consideration of Sharing Alternatives
Actions by one or more parties intending to alter the computing environment.
Consideration of available sharing options.
Access to Existing Networks or Creation of New Networks Without Extensive Planning
Implementation of the Plan
Approval/Legitimization of the Plan
The Planning Process
The process of planning to achieve the goals of intervention.
1) Statewide planning involving many post-secondary institutions
2) Systemwide planning, such as among all state colleges
3) Planning at the institutional level.
The Resulting Plan, Organizational Structures and Hierarchies
The actual plan and prescribed organizations that result from the planning process.

At all stages in the process, the contextual variable *State System Characteristics* operates.

1) Characteristics of educational institutions and government agencies.
2) Characteristics of state coordination of education and computing.
3) Characteristics of educational and state government computing.

Performance Gap Assessment

Although it is a repeating cycle, and hence has no real beginning or end, the cooperative computing process may be viewed as being initiated by a *performance gap assessment.* This is the perception by some parties of a need for expanded computer services, greater efficiency, lower computing costs, or a combination of the three. The perception of a performance gap is a manifestation of some feeling of inadequacy regarding existing computing arrangements. This assessment may be made by a number of parties: the governor, legislative agency staff, statewide coordinating board staff, or individual institutions, for example. For an assessment of a performance gap to have an effect, however, it must provoke some effort to alter the computing status quo. Such an effort is termed an intervention.

Interventions

An *intervention* may be characterized on the basis of its initiating parties and its nature. Interventions may be undertaken by a variety of institutional, state coordinating, or non-educational state government agencies, acting alone or in concert, that attempt to alter the existing computing environment. The intervention may be a direct effort to begin planning or sharing, or it may be indirect in nature, aimed at having the secondary effect of initiating cooperation. The intervention is generally preceded or followed by some consideration of sharing alternatives. Whether or not the intervention is effective in promoting cooperation depends on the nature of the intervention, the characteristics and relative power of the intervening parties, the intention of the intervention, and existing state characteristics.

Examples of direct interventions include a direct mandate to share or to plan in consideration of the advisability of sharing. Indirect interventions include moratoria on new hardware acquisitions, freezes on computing budgets, and the disapproval of specific institutional requests for increased computing power or budgets.

The statewide cooperative computing process contains a far richer variety of intervention mechanisms than do other forms of networking. Many other interorganizational environments lack authority structures and are able only to exhort their members to cooperate.[14] The state educational environment, however, boasts a variety of overlapping hierarchies having various degrees of power. As a result, the statewide cooperative computing process may experience a variety of "voluntary and

[14] Matthew F. Tuite, "Toward a Theory of Joint Decision Making" in *Interorganizational Decision Making,* ed. Matthew Tuite, Roger Chisholm, and Michael Radnor (Chicago: Aldine Publishing Co., 1972), p. 14.

coercive concerted decision making."[15] This decision making may result in a decision to share immediately, using existing or easily created networking arrangements, or to engage in a planning process.

Sharing Without Planning

In most cases, a planning activity is essential to interorganizational decision making. Planning is generally a necessary vehicle for resolving differences and reaching consensus. In some cases, however, sharing is a direct result of the intervention. This normally occurs when a readily-accessible networking arrangement already exists that will solve the computing needs assessed by the performance gap. It may also happen when the intervention mandates a particular form of sharing. Generally, such mandated, unplanned sharing is of a simple nature and encompasses small groups of institutions. However, when institutions access existing networks, their participation may eventually necessitate substantial revision in the practices of those networks.

The Planning Process

Planning may be statewide, may be conducted within a system of institutions, or may transpire among the institutions in a region of a state. The planning activity may be classified on the basis of the characteristics of the planners and the characteristics of the planning process.

It is important to know the criteria for the selection of the planners and whether those criteria were followed in order to determine if the mandate of the planning process was fulfilled. Also, the official positions and constituencies represented by the planners are important to the representativeness of the planning group. The composition of the planning group bears directly on the perceived quality of the planning process, the type of plan that is developed, and the implementation of the plan. The membership of the planning group may be small and consist of state agency personnel or it may be large and consist of representatives from many types of educational institutions, both public and private, state agencies, or consulting firms.

Finally, it is important to understand the attitudes and perceptions of the participants in the planning process. The planners' goals, commitment to cooperation, and their perceptions of the benefits and threats to autonomy of planning and cooperation are important ingredients in

[15] Roland Warren, "The Concerting of Decisions as a Variable in Organizational Interaction," in *Interorganizational Decision Making*, ed. Matthew Tuite, Roger Chisholm, and Michael Radnor (Chicago: Aldine Publishing Co., 1972), p. 23.

the ultimate success or failure of interinstitutional cooperation.[16]

To understand the planning process, one must also identify characteristics of the process as opposed to characteristics of the planners. The process may differ depending on the level and number of institutions to be covered by the plan and the size of the planning group. The style of the planning group may be coercive or participatory, and the level of planning may be sophisticated or simplistic. As in other aspects of the cooperative process, statewide planning seems more varied than planning activities associated with other forms of computer networking.

The Resulting Plan and Organizational Hierarchies

As a result of the planning process some formal plan or document is produced. This plan may be characterized on the basis of the cooperative activities that are recommended by the plan and on the basis of the organizational structures established to achieve its recommendations.

The type of cooperative activities recommended by the plan may be symbolized in several ways. While many statewide computer plans go so far as to identify specific types of sharing arrangements among clearly designated institutions, other plans identify only the goals of sharing. Still other plans take a middle ground, identifying the logical broker or vendor of computing services, but not establishing a firmly committed network. Such an arrangement is styled an "enabling network" since it sets the stage for further clarification of specific network arrangements.

Many statewide plans designate actual networking configurations in various degrees of specificity. In reality, however, the organization or hierarchical structure that is given the responsibility for implementing the computing plan (and the enabling powers conveyed by the plan to this group) is equally important in determining the ultimate success of cooperative activities.

Implementation

To many observers of cooperative computing, it might seem that the *implementation* stage of the cooperative process would consist of the mechanistic operationalization of the computing plan's blueprint for networking. This is seldom the case. The computing plan rarely makes all of the important networking decisions, and the organization charged with implementing the plan may be insufficiently empowered to achieve its task. Continued intervention by external parties may be necessary to achieve the desired level of statewide networking.

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[16] Marvin W. Peterson and John S. Waggett, "Interinstitutional Cooperation in Doctoral Education: A Report with Recommendations" (Study supported by New York Regents and Carnegie Commission, 1972).

Whereas the planning process is generally a clearly delineated activity with a distinct beginning and ending, implementation is more amorphous. Even when the computing plan stipulates specific sharing arrangements, the task of implementation may not be completed until the implementing organization makes additional decisions and sets policy. Implementation may be accompanied by *assessment of the impact of access and sharing arrangements,* a process in which external parties evaluate the effectiveness of cooperation. If implementation lags, or if sharing arrangements are not as effective as anticipated, an embryonic sense of a performance gap may develop, which may be followed by another iteration of the planning process.

USEFULNESS OF THE PROCESS MODEL OF COOPERATIVE COMPUTING

The *process model* may serve a variety of uses. On one level, it can be utilized to assess and characterize the cooperative process in any particular state or jurisdiction. It will highlight for the computing manager, as well as the education leader, the organizational, political, and technological barriers that they will encounter in establishing networking arrangements. On a higher plane, the process model can be used to characterize, analyze, and compare the cooperative processes in a number of similar jurisdictions. In this sense, it is used in the following chapter as a basis for the analysis and comparison of the most recent planning processes in all fifty states.

CHAPTER 4

Current Trends in Statewide Computing

The national survey, conducted by the authors in early 1975, yielded a wealth of data on cooperative computing processes in the fifty states. Analysis of this data and of the more subjective, perceptual findings that emerged from the case studies provided a number of conclusions regarding the process through which institutions engage in cooperative computing ventures. However, it is difficult both to convey concisely but completely the most important findings and to display the full range of findings for the more inquisitive reader. For the educator or computing manager interested in particular details for a specific state, in findings of greater detail, or in a full discussion of the analytical techniques used to verify the significance of relationships, the primary research documentation is the best source.[17]

The following discussion advances in three segments the most critical conclusions that emerged from analysis of the data on the process of cooperative computing. The first section furnishes a snapshot of the status of planning of cooperative computing in the fifty states as of February, 1975. The second describes how the states chose to deal with each stage of cooperation during their most recent planning processes. It provides a brief comparison of the similarities and differences of the ways by which states dealt with planning for, and establishing, shared computing. The final portion describes factors in each stage of coopera-

[17] Donald Merritt Norris, "The Planning of Statewide Cooperation Involving Educational Computing" (Ph.D. dissertation, The University of Michigan, 1976).

tion that have the most significant impact on the process and outcomes of planning.

STATUS OF COMPUTER PLANNING IN THE FIFTY STATES

For the purpose of this analysis, we have characterized each state on the basis of the cooperative planning and sharing activities that had occurred through February, 1975, the date on which the national survey responses were finally completed. The most current planning endeavor that was completed or begun prior to that time is referred to as "the most recent planning activity." Each state was at a different stage or in a different iteration of the cooperative computing process.

Statewide Computer Planning

As Table 4.1 reveals, twenty-six states have participated in some form of *statewide computer planning*. However, all planning activities falling within this category are not alike. Variations include planning activities for computing in: all state government agencies; all public higher education; specific types of computing in public higher education; and in regional groups of public colleges and universities. For example, three states have witnessed computer planning activities that have encompassed *all state government agencies*, not just higher education. Although such consolidated planning ventures may contain a separate plan for higher education, or may choose to exclude higher education from the sharing arrangements suggested, they do involve state government agencies and higher education jointly in the planning effort.

Of those states listed as participating in statewide planning, by far the largest number (twenty out of twenty-six) involved all or most of public higher education in a comprehensive planning activity limited to educational computing. To be chosen for this category, the state's planning process must have focused on computing at most public universities and state colleges. In some cases, community colleges, vocational/technical institutes, and secondary schools were also included. In Minnesota, for example, the planning process considered the computing needs of all public educational institutions, including primary and secondary schools. A more common pattern is exemplified by Illinois, where planning focused on the major public universities and the regional state universities.

In two states undertaking statewide planning, the scope of the plan-

TABLE 4.1

A Summary of the Scope of the Most Recent Planning Process in the Fifty States
February 1975

Statewide Planning for Educational Computing				Systemwide Planning for Educational Computing	States Having No Major "Interinstitutional" Planning		
All State Government Computing	Computing All Public Higher Education	All Public Higher Education, Academic or Administrative	Regional		Only one Public Institution in the State	Statewide Planning Appears to be Imminent	No Planning, No Immediate Prospects
1. Maryland 2. Mississippi 3. Wyoming	1. Arkansas 2. Colorado 3. Georgia 4. Illinois 5. Kansas 6. Kentucky 7. Louisiana 8. Minnesota 9. Montana 10. Nebraska 11. New Jersey 12. North Carolina 13. North Dakota 14. Oregon 15. South Dakota 16. Virginia 17. Tennessee 18. Washington 19. West Virginia 20. Wisconsin	1. Indiana (Academic) 2. Connecticut (Administrative)	1. Florida	1. California (California State College and University System) 2. Massachusetts (Massachusetts State College System) 3. New York (10 liberal arts colleges in State University of New York System) 4. Pennsylvania (State colleges and secondary schools)	1. Alaska 2. Hawaii 3. Maine 4. Nevada 5. New Hampshire	1. Iowa 2. Ohio 3. Rhode Island 4. Texas 5. Utah	1. Alabama 2. Arizona 3. Delaware 4. Idaho 5. Michigan 6. Missouri 7. New Mexico 8. Oklahoma 9. South Carolina 10. Vermont

ning process was limited intentionally to a *specific type of computing resource;* Indiana planned for the sharing of academic computing alone, while Connecticut specifically limited its attention to administrative computing.

A final variation of statewide planning is defined as *regional, statewide planning.* Although several states have experienced isolated planning activities among institutions in one or more regions of the state, Florida is the only one to have attempted coordinated regional planning encompassing all of the regions and most of the state's public institutions. At the direction of the EDP Control Board, a legislative agency, the institutions in Florida were directed to participate in coordinated planning on a regional basis.

Systemwide Computer Planning

The second major type of interinstitutional planning is *systemwide computer planning.* Four states have chosen this approach. California and Massachusetts have engaged in substantial systemwide computer planning efforts involving their system of state colleges or regional state universities. New York sponsored a major systemwide planning effort for administrative computing among the ten four-year liberal arts colleges in the State University of New York System. Pennsylvania was fostering a major computer planning and sharing activity involving both its state colleges and secondary schools in several regions of the Commonwealth.

Thus, thirty states have practiced some form of statewide or systemwide computer planning prior to February, 1975. However, the other twenty states have not been entirely inactive. For example, five of these states, Alaska, Hawaii, Maine, Nevada, and New Hampshire, have a single public university. In these states, the state university system may be able to consolidate/centralize computing resources or to extend service to computing have-not institutions or branch campuses with greater ease than in states having more complex configurations. In Nevada and Hawaii, the major computing facilities have long been located at the flagship campus, and in Maine and Alaska recent successful consolidation activities have taken place. While it cannot strictly be said that these states have not planned, neither can their intrainstitutional activities be evaluated on the same basis as interinstitutional activities between freestanding institutions.

No Planning

Five states listed in the "no planning category" appeared to be on the very edge of planning. The institutions in Iowa have recently

received a Board of Regents' directive to engage in statewide computer planning. In Ohio, the recommendation of a Board of Regents Management Improvement Program for computing in universities suggested the wisdom of computer sharing and provided a framework for planning. The Rhode Island Department of Education has taken the initiative in attempting to develop a statewide plan rather than waiting for the institutions. Statewide planning in Texas has had several false starts but appeared to be progressing; in Utah, the legislature has introduced a bill mandating statewide computing planning. Given the situations in these states, it seems entirely possible that by the time this description is published, planning may have begun in each of them.

The remaining ten states have not engaged in planning beyond the institutional level, nor do they seem apt to do so in the immediate future. Yet, even in some of these states, one could argue that statewide planning has occurred. The creation of the MERIT network in Michigan was in many ways similar to the creation of the Triangle Universities Computation Center (TUCC) in North Carolina; yet North Carolina is categorized as having planned and Michigan as not having planned. The difference lies in the definition of statewide planning. TUCC was created in response to a recommendation from a statewide planning group, while MERIT was not. Also, one must not confuse planning with networking. States like Michigan and Iowa have established successful networking ventures, but have not yet planned beyond the institutional level for cooperative computing. Moreover, categorizing Iowa, Ohio, Rhode Island, Texas, and Utah as on the verge of planning, while categorizing another ten states as not, is subjective. The interventions that we have assumed would precipitate statewide planning in the former group may fail. On the other hand, new events in any of the latter could cause planning to begin tomorrow. Nevertheless, such a classification is necessary in order to differentiate between these states for analytical purposes.

Planning as a Recent Phenomenon

Table 4.2 gives the year in which the most recent statewide and systemwide planning process was completed in each of the 30 states doing such planning. Except for the pioneer efforts of North Carolina in 1965 and the planning efforts in 1969 in Virginia (which produced a plan that has been largely ignored), all of the planning activities beyond the institutional level cited in the analysis have occurred after 1970.[18]

[18] Since this study is of the "most recent planning process," the treatment biases such an analysis toward more recent events. Other major planning activities that occurred prior to this most recent planning process included statewide planning in New Jersey (1969-70), Mississippi (1970-71), Georgia (1969-70), and Colorado (early 1970's), and systemwide planning in Maryland (1968) and Wisconsin (1970).

TABLE 4.2

Dates of Completion of Most Recent Planning Process for States Engaging in Statewide or Systemwide Planning

February, 1975

	Year											
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	In Process
Number of States	1	–	–	–	1	–	2	3	8	9	2	4

The total number of states completing a computer planning activity of a statewide or systemwide nature increased in every year of the period 1970-74. Although the data cover only a portion of 1975, there were six states in which plans had been completed or were in process by February. Statewide computer planning and sharing is clearly a phenomenon of high and continuing interest in this decade.

THE STAGES OF COOPERATIVE COMPUTING IN THE FIFTY STATES

Just as it is important to know the extent of computer planning in the states, it is helpful to comprehend the similarities and differences between the experiences of the states in developing planning. The following discussion describes the most common patterns that emerge when the process model (Chapter 3) is applied to all of the states. Recall that the stages of the process model include: 1) performance gap assessment; 2) interventions; 3) direct cooperation; or 4) a formal planning cycle; and 5) the impact of planning. At all stages of the process, state system characteristics have significant influence. States that have not planned are also included in the analysis to illustrate why some states plan and others do not. The final portion of this chapter emphasizes how these characteristics seem to influence the outcomes and success of planning and cooperation.

State System Characteristics

The mechanism for coordination of educational computing, previous planning ventures, and previous sharing of computing are the characteristics of the state's environment that have had the most significant effects on cooperative computing. In addition to these influences, the relative resistance to cooperation must be evaluated to determine a state's propensity to plan or to share.

Institutions of higher education in a majority of states have experienced some form of oversight of computing decisions, as Table 4.3 reveals. While some states allow the institutions to make their computing decisions independently, subject only to normal budgetary review, most states have some form of special review procedure for computing operating budgets and/or, more likely, for new hardware acquisitions. The major public university is somewhat more likely to have essential autonomy in computing decisions than the regional state universities, but the difference is minor. Frequently, the special review of hardware acquisition is performed on two levels; an early review by the staff of the coordinating/governing board and an additional review

TABLE 4.3

The State of Coordination of Computing Prior to the Most Recent Planning Process

February, 1975

Party Having Final Approval	Computing Operating Budgets*	New Hardware Acquisition
I. Major Universities:		
Individual institutions or campuses	17	9
Systems of institutions	0	0
Not-for-profit corporation	0	0
State Coordinating Boards/ Consolidated Governing Boards	31	17
State Government Agencies	2	24
II. State Colleges and Universities:		
Individual institutions or campuses	14	6
Systems of institutions	2	2
Not-for-profit corporation	1	1
State Coordinating Boards/ Consolidated Governing Boards	24	11
State Government Agencies	3	24

*To qualify as having a mechanism for reviewing computing operating budgets, a state must have a review procedure for computing budgets that is distinct from normal budgetary review.

by a state government agency. Not only are special reviews of computing quite common, but also they seem to be powerful determinants of whether a state will engage in planning and cooperation. States having these special review procedures are far more likely to engage in planning.

However, the case studies reveal that the structural form of computing coordination is inadequate as a lone predictor of cooperation. To achieve the best reading possible, one should combine an assessment of structure with an independent evaluation of the relative resistance to cooperation. This resistance is expressed most commonly by the major public university that is attempting to maintain its autonomy; by state colleges and universities that are afraid of domination; and by have-not institutions that are wary of insensitive computing service.

Previous planning and sharing activities in a state were confirmed as major factors influencing the most recent planning process. From Table 4.4 it is clear that while most states had engaged previously in some form of cooperative computing, only eight states did so because participation in cooperation was mandatory or "required." Further, while slightly more than half of the states had witnessed some form of "interinstitutional planning," most of these ventures were unambitious, and only four states had participated at a level that could be considered statewide planning.

States having previous planning and sharing experiences are more likely to participate in systemwide or statewide planning. In addition, the planning process is likely to be more directive, and the planning outcomes are more ambitious or clearly defined in these states. To identify the specific effects that previous cooperation would have on future efforts, it is necessary to evaluate carefully the full extent, success, and perceived quality of existing networks. In many states, the impact of previous sharing is largely attributable to the existence of NSF-sponsored networks, which had been used as the basis for the establishment of a statewide computing network. Previous cooperative activities had "broken the ice," had removed defenses against cooperation, and had given individuals the opportunity to work together. Experience with planning and cooperation had identified the elements of a successful cooperative venture and the true limits of cooperation. For these reasons, planning was more likely, more directive, more comprehensive, and more successful the second time around.

Assessment of a Performance Gap

The first stage in the initiation of planning is the assessment of a performance gap. In many states this assessment was motivated by a

TABLE 4.4

Computer Planning and Sharing Prior to the Most Recent Planning Process

Level of Planning	Number of States	Type of Sharing	Number of States
Institutional Level	50	Access to Facilities of Another Institution	41
Branch Campuses of a Single Institution	17	Utilized Commercial Service Bureau	22
Between Institutions Within a System of Institutions (e.g., two state colleges)	10	State Government Agency Provided Service	9
Between Institutions From Different Systems (e.g., a state college and a community college)	4	Utilized Not-For-Profit Corporation	1
		Engaged in Bidirectional Sharing	16
Statewide Planning (Involving representatives from many institutions from different systems)	4		
Total Number of States Participating in Some Form of Computer Planning Beyond the Institutional Level	26	Total Number of States Having Some Form of Sharing	43

history of rapidly increasing computing expenditures and proliferation of hardware. The case studies revealed that the performance gap assessment was performed by parties external to the institutions, such as the staff to key legislative committees, the coordinating/governing board, or to a system of institutions. While the institutional computing personnel may have recognized similar problems, their solutions involved greater institutionally-based computing power, not interinstitutional cooperation. Once a performance gap was perceived by external parties, it was followed quickly by an indirect intervention or by a direct mandate to plan for sharing, as Table 4.5 illustrates.

Most performance gap assessors were convinced that cooperation was virtuous. In general, they were inadequately equipped to assess the real effectiveness of computing cooperation or to measure whether the outcomes would be congruent with their expectations of expanded service at lower costs. Because they lacked direct experience in planning, the parties assessing performance gaps and initiating interventions could not appreciate the limits of cooperation in statewide planning. It has not yet been demonstrated whether these external parties have moved beyond a simple faith in the virtue of cooperation toward a vigorous assessment of the limits to cooperation.

Interventions

While some states possess the capability and will to mandate planning directly, in others the path is more circuitous. As shown by Table 4.5, fully thirty-five states experienced some form of intervention either prior to or as an integral part of the most recent planning process. The moratorium on new hardware acquisition, the computing budget freeze, and the disapproval of specific computing decisions of individual institutions were the most common forms of intervention. However, there were other indirect means of intervention. In some states, planning was initiated by the institutions because a mechanism for hardware review had been vested recently in a new, aggressive state agency, and it was clearly preferable to steal a march on the new agency rather than wait for inevitably harsher treatment.

Interventions most often follow the lines of authority established by the process for computing coordination, and more powerful mechanisms for review tend to lead to a greater number of more ambitious interventions. However, since some states have the power to mandate planning directly, without interventions, the intervention is not absolutely necessary or sufficient for planning to occur. Nevertheless, the existence of interventions seems to have an appreciable impact on the nature of the outcomes of planning. Apparently the intervention, or

TABLE 4.5

Summary of the Cooperative Processes in the Fifty States

Stage in the Cooperative Process	Conditions in the Fifty States
PERFORMANCE GAP ASSESSMENT	Assessment of performance gap was made by staff to key legislative committees, coordinating/governing board, or system of institutions. These assessments were based on a history of rapidly increasing computing expenditures and proliferation of hardware. They were followed by direct or indirect intervention.
INTERVENTIONS	*35 states* experienced one or more interventions. The most popular were moratoria on hardware acquisition (18 states), specific disapproval of institutional requests (15 states), and a freeze on computing budgets (8 states). In *16 of 30 states* that had planned, the coordinating/governing board provided the mandate.
THE PLANNING PROCESS	
Scope of Planning	Statewide planning (26 states) and systemwide planning (4 states) were chosen.
Type of Planning	Consultants alone – 3 states Planning Committee(s) – 10 states used one committee, 8 used two committees Staff + Advisory Committee – 9 states
Membership of the Planning Groups	The membership composition of each planning group reflected the historical conditions and peculiarities of each state. Generically, however, the same sorts of constituencies were represented: Institutional representatives – 24 states State Government – 23 states Consultants – 9 states

Continued

TABLE 4.5 (Continued)

Summary of the Cooperative Processes in the Fifty States

Stage in the Cooperative Process	Conditions in the Fifty States
THE PLANNING PROCESS (Cont.)	
Selection of Planners/Chairperson	Planners were selected on the basis of computing expertise and as representatives of specifically designated constituencies. Planners were appointed by the institutions. Chairperson was appointed by the external mandating party.
Directions Given the Planning Group	In *10 states* the planning group was told to investigate the desirability of sharing, and if it were desirable, to plan for cooperation. In *16 states* the directions were to plan for sharing, the *advisability of sharing being accepted as given.*
Leadership and Influence Patterns	Early in the process, the staff of coordinating/governing boards exerted the most influence. As the process proceeded, the representives of major public universities played major roles. Representatives of state universities were also important.
THE IMPACT OF PLANNING	
General Outcomes of Planning	Most states were not "definitive" in their computing plans. Implementation was used to "flesh out" cooperative arrangements that were suggested or enabled in the computing plan. 1 state – Decided not to create new cooperative arrangements 2 states – Established goals alone 6 states – Created Enabling Network and Goals 2 states – Created Specific Sharing (with or without goals) 16 states – Created Enabling Network and Specific Sharing Arrangements (with or without goals)

Types of Networks Recommended	Many different networking arrangements came to be established: 6 states – Potential Brokers Specified (Enabling Network alone) 10 states – Star Networks 5 states – Distributed Networks 2 states – Regional, Stand alone networks 1 state – Regional Networks, Linked to Central Facility 2 states – Regional Networks, Linked to Distributed Networks
Participation in Sharing	Most plans stipulated the general purpose sharing of computing resources, the details to be worked out during implementation. Most states *required* the participation of the major public university, as vendor or broker. The state universities often were not required to participate, but were advised they would experience difficulty in securing comparable services from sources outside the network.
Implementation Structures	The implementation of the computing plan was viewed as a key element in the success or failure of cooperation. Several forms of implementing organization were established: 1 state – Decided not to create new sharing arrangements 3 states – No implementing organization (Institutional responsibility) 15 states – Advisory Committee + Staff of Coordinating/Governing Board or System of institutions 2 states – State Government Agency 5 states – Independent legal body (not-for-profit corporation)

Continued

TABLE 4.5 (Continued)

Summary of the Cooperative Processes in the Fifty States

Stage in the Cooperative Process	Conditions in the Fifty States
Implementation Structures (Cont.)	Where an implementing organization was created, its reporting structure was important: 17 states – Implementing organization reports directly to state agency 5 states – Reports to an independent board of directors 1 state – Reports to executive branch of state government 1 state – Reports directly to legislative branch of state government 1 state – Reports to formalized association of educational institutions The responsibilities of the implementing organization were also important: 11 states – Implementing organization was only to direct operationalization of the plan; would not provide computing services 4 states – Would serve as a broker of services but would not own or operate computing resources 2 states – Would act as facilities manager for educational institutions in providing computing services 9 states – Would own and operate its own facilities while providing computer resources to educational institutions 1 state – Responsibilities not yet decided
Provision for Effectiveness Assessment	Only *7 states* provided any provision for effectiveness assessment.
APPROVAL OF THE PLAN	In most states there was a formal approval process (19 of 25, with 4 expecting such a process in the near future). Most of these approvals accepted the plan without revision.

the implied threat of additional intervention if planning is not forthright, motivates many states to produce more ambitious, comprehensive plans. Interventions provide a mechanism for intervening parties (the staff of coordinating boards, legislative agencies, and state government agencies, the Legislature, or the Governor) to exert influence unobtrusively on the planning process and affect the outcomes of planning without being the most active participants in the planning process.

The Planning Process

Every state is somewhat unique in the different combination of planning groups that have been mobilized to plan for cooperative computing. The possibilities run the gamut from Massachusetts, which used a team of consultants to create a plan, to Illinois, which utilized a "staff committee" of five individuals and three advisory committees composed of scores of persons in the planning process. Upon closer scrutiny, however, it is clear that one may classify the states into certain generic categories, based on the characteristics of their particular planning process. Comparison of the states on this basis then leads to some conclusions about the impact of the planning process.

Types of Planning. Three primary types of planning groups emerge from this categorization. First, several states used *consultants alone* to devise their computer plan. This approach, the least popular, was chosen by only three states. On the other hand, the most commonly chosen planning approach was to mobilize one or more *planning committees* or planning task forces. Of the eighteen states that opted for this approach, ten selected a single planning committee, while eight chose two committees operating in sequence or concurrently. The third type of planning group is somewhat different from the planning committee approach. In the *staff + advisory committee* mode the staff of the coordinating board or some state agency functioned as the directive party in planning, assisted by some form of advisory committee structure. The difference between the "staff + advisory committee" and the "planning committee" approach is based on a subjective determination of the role of staff. The staff + advisory committee mode of planning provided greater directiveness in the process. It also enabled the involvement of greater numbers of participants on the advisory committee. While most planning task forces were composed of ten or fewer participants, the advisory committee often involved between ten and forty persons; this was possible because management and control of the process were provided by the staff component, composed of fewer than five individuals.

Membership of the Planning Group. The membership of the planning group is also an important consideration. The numbers of participants

from different constituencies reflect the historical conditions and peculiarities of each state. Yet when one groups the participants into categories, several clear observations emerge. Of the twenty-seven states that provided information, all but three (those that used consultants alone) involved representatives of the educational institutions and all but four involved representatives of state government (staff of the coordinating board, state agencies, legislative agencies, or the Legislature). In addition, nine states involved consultants or industrial representatives to provide some form of unbiased "external expertise." The balance of influence between these groups of representatives could not be judged on the basis of numbers alone, however, but required an individualized assessment of the influence patterns in each state's planning process.

Planners were selected on the basis of two criteria: 1) possession of a certain level of computing expertise, either of the technical or managerial/policy variety; and 2) representation of specifically designated constituencies. The chairperson of the planning group was designated, in most cases, by parties external to the planning process. Interestingly, in over half of the states providing information, the advisability of sharing was accepted as given, and the planners were told to plan for sharing. In the remaining states, the planners were merely told to consider the desirability of sharing; if sharing was found desirable, they were then to plan for sharing.

Final analysis illustrates that the inclusion of institutional and state government representatives and the manner of selecting planners do not produce measurable differences in the outcomes of planning. Most states included institutional and state government representatives in the planning group and selected planners in reasonably similar ways. However, the inclusion of external experts in the planning process does cause differentiable results. Consultants, especially those from out-of-state, are far more likely to suggest the creation of a not-for-profit corporation as the implementing organization. These consultants may serve as the instruments for transmitting innovative networking ideas, such as the not-for-profit corporation. Even more important are the directions given the planning group. States that were told to plan for sharing, the advisability of sharing having been accepted as given, were far more apt to produce a computing plan that stipulated goals, that created an enabling network, that established specific sharing arrangements, and/or that formed a not-for-profit corporation. In many ways, such directions served as a form of intervention, provoking more comprehensive and ambitious planning outcomes.

Even the most powerful of these structural factors do not explain the outcomes of planning adequately. Given the similarities in the

structural components of planning, the role of individual leadership assumes special importance. The case studies identified a number of recurring leadership styles and patterns that contributed to the success of planning.

Leadership and Influence Patterns. Measurements of influence at different stages in the planning process revealed that the staff of the coordinating board and/or state government agency was the single most influential party in initiating planning. This is congruent with the key role of staff as agents of intervention or sources of direct mandates to plan. The influence of these external agents was paramount in providing the initiative to start planning, and often continued to shape outcomes, even if the active participation of these individuals waned.

As the planning process progressed, the representatives of the major public university became the single most significant group, although in some states the influence was distributed fairly equally among representatives of different types of institutions. Many of the representatives of the major public university resisted participation in sharing activities. Others chose to assume a more "statesmanlike" posture, and maintained their computing superiority by participating in planning and by leading the planning process. In these cases, the administration of such institutions had to assuage the concerns of their own faculties, who feared losing computing resources. They also had to counter pressures from state government representatives who may be tempted through lack of understanding to press for overzealous sharing.

The posture of the major public university often shaped the role played by the representatives of other institutions, especially the regional state universities. In many cases, these institutions felt that, while they had input into the planning process, the outcomes inevitably reflected the interests of the major university. Strong representative leadership was required for these institutions to overcome the natural tendency of every institution to want its own computer. Equally important, the fear of being dominated by the major university was a potent threat, especially in states with a history of insensitive service by the major university. In some states, enlightened leaders were successful in convincing the regional state universities that the benefits of bypassing several generations of computing development by accessing the computing facilities of a major university of networking facility justified the risk.

To summarize, the structural components of the planning process explain a certain amount of the variance in planning outcomes. The participation of external consultants and the provision of firm directions to plan and share are likely to prompt the creation of more ambitious and comprehensive plans. However, personal leadership and

patterns of influence, are more powerful than structural factors in shaping the outcome of planning in a particular state. Leadership of individuals is crucial far more often than the configuration or composition of the planning process.

The Impact of Planning

State computing plans and related agreements outline the outcomes of planning including the types of networking arrangements, and the nature of participation required of different institutions. In many states, the computing plan was a general, consensus-seeking document that did little more than agree upon goals for cooperation; in other states, the plan provided goals for cooperation, an organizational structure to assist the network in achieving these goals, and specific types of sharing that would occur. Even in states which crafted comprehensive planning documents, however, the process of implementation was critical to the operationalization of cooperative efforts.

Outcomes of Planning. As Table 4.5 shows, states have provided one of four combinations of these general outcomes in their plan: providing goals alone, establishing goals and an enabling network, creating an enabling network and specific sharing (with or without goals), or creating specific sharing alone. Most states used the plan as a vehicle for identifying the goals of cooperation. If they did not, it was generally because the goals were already agreed upon or existing networks made it unnecessary to reiterate goals. Most states also created some form of enabling network. These "networks" identified the logical broker, vendor, or implementing body, but did not mandate specific sharing arrangements among clearly identified institutions. In this way, planners furnished an enabling structure that could be fleshed out later. In addition, eighteen states did utilize the computing plan as an instrument for creating (or recognizing) specific cooperative ventures.

Types of Networks Recommended. The type of network recommended by the plan is another important outcome of the planning process. Several patterns emerge among those states that recommended cooperation. The six states that created enabling networks went only so far as to identify the potential vendor or broker for delivering computing services. In Arkansas, for example, the University of Arkansas at Fayetteville was designated as the logical broker in an ultimate statewide network, although no specific sharing was identified.

Among the remaining states that actually specified sharing, the majority recommended some form of star network. While most of the star networks linked computing have-nots with the facilities of the major computing institutions, others were somewhat more complicated. Florida created a series of regional, stand-alone, star networks, and

Mississippi proposed linking existing star networks in different regions of the state with a central computing facility. The remaining states suggested networks that were distributed in form and structure. Kansas designated its proposed network a "partially distributed" network because it linked only a portion of the existing computing facilities. Kentucky's plan proposed to create a distributed network, the major facilities of which would serve as "nodes" for star networks servicing smaller institutions in different portions of the state.

Participation in Sharing. Most plans stipulated the general purpose sharing of computing resources; the details were to be worked out during implementation. The majority of the states required that the major public university participate in the cooperative venture, the extent of which was often left to further negotiation. The regional state universities, either as a group or individually, were less likely to be required to participate. However, they were often advised that they would experience great difficulty in securing new hardware or computing services from a source other than the new network. Most plans thus served as a deterrent to future proliferation of computing and expenditures, rather than a redistribution of existing facilities and services.

Recall that certain factors in earlier stages of the cooperative process led very clearly to these planning outcomes. Participation in previous planning activities—especially those involving NSF-sponsored networks—was conducive to the production of plans that produced statements of goals and specific sharing arrangements. States having previous NSF-sponsored networks were also more likely to require the major public university and regional state universities to participate in the networking arrangements. The participation of consultants on the planning committees often led to the creation of an enabling network. But the most potent effects on planning outcomes were levied by interventions and by the directions given the planning group.

States that had experienced interventions were far more likely to specify goals in their computing plan, and to require participation by the universities and state colleges. States that were told to plan for sharing, an intervention of sorts, were more likely to create enabling networks and specific sharing arrangements. They were also somewhat more prone to select distributed networks.

The quality of a computing plan and/or networking scheme is dependent not only on its ambition or comprehensiveness, but on its appropriateness to the cooperative goals and characteristics of the particular state. Nevertheless, it is abundantly clear that active interventions by external parties have contributed to the development of plans calling for more comprehensive and ambitious computing ventures.

States that plan without interventions, or initiate cooperative ventures without statewide planning, attempt less comprehensive sharing arrangements.

Implementation Structures. The process through which states operationalize their computing plan (or fail to do so) is a most important and complex segment of the cooperative cycle. Chapter 6 evaluates in depth the conclusions reached by analyzing implementation in three states. Although the process of implementation is important, the structure of the implementing organization also influences the success of implementation efforts. The types of implementing arrangements established by statewide plans and related agreements are displayed in Table 4.5. Of those plans that recommended the creation of new sharing arrangements, only three opted for leaving the responsibility for implementation solely with the individual institutions. The remaining states constituted some form of implementing organization, either by designating an existing agency or by establishing a new organization. The most common type of implementing group consisted of the staff of a coordinating board or system of institutions working with a network advisory committee. However, several states designated a state agency as the implementing group and five states established an independent body (not-for-profit corporation) to serve as implementing and networking agency.

The reporting protocol of the implementing group is also important. Most states required the implementing group to report formally to a state agency, legislative branch of state government, or a formalized association of educational institutions. However, the not-for-profit corporations reported to an independent board of directors. Most of the implementing organizations established some sort of advisory, technical, or users committee structure to provide input on network design, policy and practices.

The computing plans in different states envisioned many different roles for the implementing organization in providing computing services. As Table 4.5 illustrates, in eleven states the implementing group was designed to direct only operationalization of the computing plan; another body was supposed to provide computing services. In the remaining states, however, the implementing group was designed to: serve as a broker of services but not to own or to operate computing resources; own and operate facilities while providing computer resources to participating institutions; or to act as "facilities manager" for educational institutions' computing services.

Although the computing plans of some states provided for the assessment of effectiveness and/or future planning activities, most of these provisions were very general. No states stipulated how the effec-

tiveness of cooperative ventures would be assessed. Provisions for future planning only designated the party who would be responsible for planning in the future.

In summary, several factors emerge as determinants of the characteristics of the implementation structures established by the computing plan. States that experienced interventions were more likely to: create a new implementing organization, stipulate the assessment of effectiveness, and provide for future planning efforts. While most states designated an implementing group that reported to state government, the independent not-for-profit corporation constituted an important new form of implementing organization. The independent not-for-profit corporation was most likely to be established in states demonstrating one or more of the following characteristics: external consultants were involved in the computing plan; the institutional representatives were not limited to computing center directors but included administrators and users, as well; the planners were directed to plan for sharing.

The major conclusion that one reaches from assessing implementation structures is that even the most comprehensive implementation structure is only the barest of beginnings in operationalizing a computing network. Even in those few states whose plans specify goals, enabling networks, specific sharing arrangements, and an organizational structure, the implementation structure for a computing cooperative is only the arena in which the crucial operational issues are determined.

The implementation activities cover a long period of time and may involve several fresh starts and reconfigurations of the original plan. Few of the states that had completed plans had also completed the evolution of a mature computing network.

Approval of the Plan

Approval of the computing plan was straightforward in most states. The coordinating board and its staff were usually the parties of approval, and they approved (or were expected to approve in the near future) the plan without revisions.

The relative predictability of the approval process is probably attributable to several factors. Most of the difficult battles appear to have been waged within the planning group, and the final findings represented consensus. Since most plans did not specify a blueprint for cooperation, many of the controversial issues remained to be solved. In addition, the role of interventions and the "invisible hand" of state government appear to have guided the planners to produce a plan that will be acceptable to the external agencies of review. Finally, since cooperative computing is an area that is essentially foreign to most

governors, legislators, and coordinating board staff, these parties are satisfied by the existence of some form of broadly based cooperation. These factors tended to make approval of the plan a pro forma exercise.

AN OVERVIEW OF THE EFFECTS OF THE COOPERATIVE PROCESS

It is difficult to identify, with elegant precision, the factors which have the greatest impact on cooperative computing. Some factors influence all stages in the cooperative cycle, and the factors in each stage of the cycle exert impacts on succeeding stages. Some factors do not exert substantial impacts until two or three stages later in the cycle. Even the most significant single relationships do not explain a sufficient portion of the variance in outcomes to instill complete confidence in using these relationships as predictors. Nevertheless, the analysis has revealed the factors that appear to be conducive to the establishment of certain planning outcomes and to the manner in which cooperative ventures are operationalized. These findings are summarized in Table 4.6.

It must be emphasized that evaluating how and why certain outcomes are generated does not answer adequately the question of whether those outcomes are desirable for the particular state in question. The following chapters on implementation and networking structures provide a better assessment of the desirability of the networks that have been created. The analytical scheme in that chapter also provides a framework for conducting an evaluation of the effectiveness of computing cooperation especially those different types of sharing that have arisen in response to different intervention and planning processes.

The following list of conclusions summarizes the findings discussed in this chapter.

1. Many states engaged in some form of planning and sharing activities prior to the most recent planning process. However, in most states, these prior activities were limited in scope and ambition, and participation was not required. While states that engaged in previous planning are somewhat more likely to participate in planning, the most significant impact is exerted on the process and outcomes of planning. States that have experienced previous planning/sharing are prone to utilize "more directive" types of planning. Moreover, participation in previous planning is apt to lead to computing plans that stipulate specific sharing arrangements and/or means for assessing effectiveness.

2. In many states colleges and universities have their requests for new hardware and/or computing operating budgets subjected to a special review by the staff of a state coordinating board, a non-educational agency, or both. Not only are these review authorities widespread, they are powerful; states with these special review procedures are more likely to experience interventions and to participate in inter-institutional planning.
3. The assessment of a performance gap is performed by parties external to the institutions. These parties use the channels of computing coordination to either mandate planning or invoke interventions designed to encourage planning. Thirty-five states have experienced such interventions.
4. The impacts of these interventions touch every subsequent stage in the cooperative process. Intervention contributes to a state's propensity to plan. Unlike the mechanism for computing coordination, however, interventions also have impact on planning outcomes. States experiencing interventions are far more likely to specify goals in their plans, to require that institutions participate in the network, and to provide for implementation structures, the assessment of effectiveness, and future planning.
5. The propensity to participate in planning is affected significantly by the experience of interventions as well as by the existence of computing coordination. The type of planning group and constituent representation that was chosen reflected the individualism of each state. Yet most states involved representatives from the educational institutions and from some branch of state government, occasionally including external consultants in the process. Most planning groups could be easily classified as a team of consultants, a planning committee, or a "staff & advisory committee" (a variation which gave greater directive powers to the staff component). States that have engaged in previous planning are more likely to choose this latter, more directive form of planning.
6. The most influential parties in the initiation of the planning process are the external, intervening parties such as the staff of the coordinating board or non-educational agency. The most influential parties during the actual process of planning are the representatives of the major public university, often followed closely by representatives of regional state universities.
7. Few correlations exist between the structures and outcomes of planning, due to generic similarities among states. However, the participation of external consultants in planning is the most significant determinant of the likelihood of establishing a not-for-profit corporation. In the absence of powerful structural factors, the

TABLE 4.6

Summary of the Most Powerful Factors in the Process of Cooperative Computing

Factors Which Affect This Stage Most Significantly	STAGE IN THE COOPERATIVE PROCESS	Later Events Which Are Influenced Most Significantly By This Stage
	STATE SYSTEM CHARACTERISTICS	
–	*Previous Planning and Sharing*	1. Propensity to plan and type of planning 2. Computing plan's provisions for specific sharing and effectiveness assessment
–	*Computing Coordination*	1. Propensity to experience interventions 2. Likelihood of participating in planning
Review of Requests for Computing Hardware	*INTERVENTIONS*	1. Propensity to plan 2. Outcomes of Planning: Specification of goals, required participation of institutions, implementation structures, effectiveness assessment
	THE PLANNING PROCESS	
Previous Planning	*Mandating Party*	–
Review of Hardware and/or Computing Budgets and Experiencing of Interventions	*Propensity to Participate in Planning*	–

Existence of Previous Sharing (NSF-sponsored network)	*Type of Planning*	1. Membership composition of the planning process 2. Participation in sharing
Type of Planning	*Participation in Planning*	Participation of external consultants is important to implementation
Experiencing Interventions	*Directions Given the Planning Group*	Outcomes of planning and type of network

THE RESULTING PLAN, ORGANIZATIONAL STRUCTURES, AND HIERARCHIES

Experiencing Interventions	*Outcomes of Plan: Goals*	–
Directions Given the Planning Group	*Outcomes of Plan: Enabling Network*	–
Directions Given the Planning Group and Previous Required Sharing	*Outcomes of Plan: Specific Sharing*	–
Directions Given the Planning Group	*Network Type*	–
Experiencing Interventions	*Required Participation in Sharing*	–
Experiencing Interventions	*Implementation Structures*	–
Previous Planning	*Provisions for Effectiveness Assessment*	–
Experiencing Interventions	*Provisions for Future Planning*	–

personal leadership of individual planners assumes great importance in determining the success of planning.

8. The directions given the planning group are among the most important contributors to the type of network chosen and to the likelihood of identifying specific sharing arrangements. The state that is told to accept cooperation as desirable, and to therefore plan to share, is far more likely to create an advanced plan: one that provides goals, creates an enabling network, specifies sharing arrangements, and/or creates a distributed network.
9. Taken in total, the outcomes of planning and the structures of implementation are determined by the nature of the planning process, state characteristics, and interventions. If we treat the practice of directing a state to share, the desirability of sharing being accepted as given, as a form of intervention, then it is clear that interventions are the most powerful determinants of planning and implementation structures.
10. The provisions of the plan and the structures of implementation are not the final word in the establishment of networking. Some states do not even follow their computing plan once it is completed. Even in those states that follow a comprehensive plan (i.e., specifies goals, an enabling network, specific sharing, and organizational structures), the creation of an operational consortium remains a formidable task.

The analysis of the state of computing using the process model has shed light on the determinants of and barriers to cooperation in establishing networking arrangements. The following chapters on implementation and networking characteristics explore the question of how to assess which networking structures and services are congruent with a state's needs and characteristics.

CHAPTER 5

A Structural Model of Cooperative Computing Organizations

The results discussed in the previous chapter provide an overview of the iterative process of cooperative computing from performance gap assessment through implementation. The next two chapters focus on one stage of that cooperative process, namely implementation, and emphasize the products of networking. In this chapter a structural model is presented for comparing and contrasting the structure and other characteristics of implementing organizations. Then, this scheme is used in chapter 6 to characterize the experiences of three states in implementing statewide computing consortia.

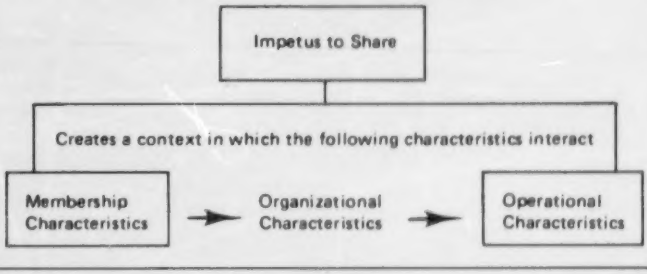
Since cooperative computing organizations are relatively young, there exists no extensive bank of historical information on the events pertaining to implementation of computing networks. As a first step in understanding implementation, the important organizational characteristics of computing consortia should be defined. Such a model must recognize the importance of the technological aspects of networks but should not overemphasize them. Similarly the economic, political, and organizational characteristics in which a computing network exists must be highlighted. This structural model attempts to meet these objectives.

For the purposes of the structural model, network characteristics are divided into three interrelated groups: membership characteristics, organizational characteristics, and operational characteristics. These characteristics are examined in the context of the events which preceded the establishment of the network and are termed the "impetus to share."

In the following discussion each of the characteristics of network structure is considered separately, and the dimensions of specific

elements of structure are presented. The next chapter then relates these elements to the actual experiences of three states. As an overview, the structural model is summarized graphically in Figure 5.1.

FIGURE 5.1.
A Structural Model of Cooperative Computing Organizations



IMPETUS TO SHARE

A first step in understanding the establishment of a computing consortium is to trace the forces which led to its formation. This history places cooperative computing in the context of its environment and provides background information on the possible causes of subsequent events. Although many events may impact on the formation of a network, for purposes of the structural model, three historical characteristics have been singled out: the interventions, the planning process, and the degree of participation required in the resource-sharing consortium. The impetus to share is a result of the total planning process, complete with its successes and failures. It is an attitude which emerges from preceding events and, in large part, is the context in which membership, organizational, and operational characteristics interact.

MEMBERSHIP CHARACTERISTICS

An important set of characteristics of any computing cooperative is the set that describes members or participants who comprise the network. For example, in the case of the MERIT Computer Network, the three members are each institutions; in the case of ARPANET, members are academic departments and research installations; and in the case of the proposed PACIFIC RIM Network, the members will be

nations. As Table 5.2 illustrates, membership characteristics considered here include: number, geographic distribution, diversity, computing environment, computing goals, and previous cooperative experience. Each of these membership groups translates into different operational considerations. For example, if a large number of members comprise the network, a very different mode of operation will be required than for a network with few members or users. The *geographical distribution* of its members will also affect the implementation of the network. If network members are distant from each other, it is difficult to hold face-to-face meetings. An international network can encounter operational problems that will not confront the local computer utility. Geographical distribution of members also translates directly into communication costs which, in turn, affects operation.

TABLE 5.2

Membership Characteristics

Variable	Dimension of Variable
A. Number and Size	Count
B. Geographical Distribution	Local . . . . . International
C. Membership Diversity	Like . . . . . Unlike
D. Computing Environment	
1. Number of Available Computers	Count
2. Sophisitication of Existing Computing Systems	Low . . . . . High
3. Degree of Access	Low . . . . . High
4. Sophistication of User	Low . . . . . High
E. Previous Cooperative Experiences	
1. Type	a. Hardware b. Software c. Support Services d. Communications
2. Benefits	Negative . . . . . Positive

Another important characteristic is the *membership diversity* of the computing consortium. The answer to the fundamental question, "How similar are these members?" holds many operational ramifications. A major research institution requires different computing services than does a two-year community college, and a network that serves a wide diversity of clientele must assume a wide diversity of expectations and service demands.

Membership characteristics also must be expanded to encompass the *computing environment* on each campus. The number of computers, the degree of access to hardware,[19] and the sophistication of network users will influence the establishment and operation of any computer network. A highly sophisticated environment with many years of experience in computing will require a different set of services than a consortium which serves "have-not" institutions which are only beginning to tap the administrative and instructional potential of computing.

Finally, the *previous cooperative experiences* of network members must be taken into account. Members with experiences in linking institutions via computing will possess an appreciation of the problems of negotiation and coordination. Previous hardware networks may have built a reservoir of expertise in telecommunications and networking that will be beneficial in operationalizing a new consortium. Most importantly, the benefits obtained from these prior experiences will strongly influence the attitude with which members approach the new consortium. Strong, positive experiences with resource sharing form attitudes and personal relationships that later can become valuable aids in implementing a network. In contrast, the ill-will created by an unsuccessful prior cooperative venture (perhaps not even related to computing) may hinder the establishment of a new network. Such experiences must be taken into account when strategies for implementation are planned.

Any one of these membership characteristics may not suggest any best implementation strategy; yet when viewed as interdependent factors that determine the operation of a cooperative utility, they provide some insight into implementation policy.

ORGANIZATIONAL CHARACTERISTICS

The structural model singles out five organizational characteristics of a network: domain, formal organizational structure, governance pat-

[19] The simplicity of this language is not intended to mask the complexity of issues impacting on access. Factors such as cost, ease of operation, hours available, and many others all impact on user access.

terns, funding sources, and configuration of computing services (see Table 5.3). Each of these can be viewed as a unit of analysis which highlights an important aspect of network organization.

Underlying the organizational structure of any computing cooperative is its *domain*. Domain defines the organizational space which the network occupies including "relationships to other organizations" and the "scope of network responsibility." If, for example, the network is constituted as an independent organization (e.g., not-for-profit corporation), it will probably have more freedom to define its own operating policies than if it is part of an existing educational agency. Budgetary and procurement implications will flow from this. A statewide consortium may also transcend the boundaries of existing organizations. For example, a consortium may pull together for the first time the private and the public educational sectors. If this is to occur, special legislation may be needed to join public and private agencies. Also, the relationship of existing sharing arrangements to the new consortium is an important organizational characteristic. For example, existing cooperative ventures may become a part of the new consortium or they could be viewed as a competitive source of computing.

A second aspect of domain is the scope of network responsibility. For example, some cooperatives are established only to provide one type of computing service (e.g., instructional time-sharing). Others have broader responsibilities and have the authority to offer all types of computing services. Furthermore, a network may not only have the responsibility for computer sharing but may include other forms of resource sharing such as cooperative purchasing and joint financing.

The formal structure of the consortium is the type of legal entity or official organization that is established for the network. The formal structures of state educational networks can be examined in five groups: non-educational state government agency, office within a coordinating/governing board, independent legal body, special committees, and a range of other alternatives. Boards of directors, standing committees, and rules of network governance all comprise the formal structure of the network. The interrelationship of these components is usually presented most succinctly by the organizational chart. Each state network differs. The structure that is selected is not important in and of itself. Rather, it must be consistent with the impetus to share and the membership characteristics of the consortium. Ideally, the appropriate structure facilitates effective policy enactment.

Even more important than organizational structure is the actual governance of the network. If a consortium is effectively governed and

TABLE 5.3

Organizational Characteristics

Variable	Dimension of Variable
A. Domain	
1. Relationship to Other Organizations	Dependent . . .Overlapping . . Independent
2. Scope of Network Responsibility	Single Purpose Computing / General Purpose Computing / Other . . Sharing
B. Formal Structure	a. Non-Educational Agency b. Office Within Coordinating/Governing Board & Advisory Committee c. Independent Legal Body d. Special Committees e. Others
C. Governance	
1. Formal Process Utilized for Decision-Making	Description
2. Influence Across Constituencies	No Influence . . . . . A Great Deal of Influence
D. Funding	
1. Developmental Phase	External . . . . . Internal
2. Operational Phase	a. Equal Fixed b. Unequal Fixed c. Sharing According to Usage d. Sharing According to Pledges e. Open Market
E. Configuration of Computing	
1. Hardware	a. Star Network b. Distributed Network c. Single Facility Sharing
2. Software Development and Maintenance	Decentralized . . . . . Centralized
3. Support Services	Decentralized . . . . . Centralized
4. Communications	Non-technological. . . . . High Speed

provides the services desired, problems inherent in other aspects of the network's operation may be overcome.

Although many different facets of operation comprise the governance of a network, for the purposes of this study governance has been restricted to two aspects: the "formal process utilized for decision making" and the "influence patterns across constituencies." The procedures used for decision making highlight which parties are consulted on policy decision and how decisions actually get made. For example, a network whose policies originate with the network staff and then are "rubberstamped" by the board of directors will have a very different operational character than a network whose policies often originate with member-users and are then approved only after a debate by the network staff and the board of directors.

The "influence of various constituencies" on policy decisions is the second component of governance. For example, a network that is predominantly influenced by the major state university will be responsive to a different set of needs than a network governed by the community colleges. Members' perceptions of each other's influence will often dictate interactions and affect the outcome of policy debates.

Another important organizational characteristic is the funding source(s) of the computing consortium. In examining these fiscal aspects, it is important to distinguish between the network's developmental phase and its operational phase. Development of network capabilities requires special, one-time financial resources to create systems, test services, and set-up offices. For some consortia initial seed money has been provided by a federal grant (externally), while other networks have been started with a direct appropriation from the state government (internally). The source of developmental funding does not dictate any particular pattern of implementation, yet the type of source may suggest certain expectations and commitments. A consortium that has been started with a large federal grant does not imply the same commitment to continued operation as a network funded by a special appropriation from the state legislature.

The operational phase of funding requires a stable financial structure that will foster network planning and allow for smooth operation. A recent study[20] on computer resource sharing suggests four possible alternatives for funding an interinstitutional network:

- equal fixed sharing
- unequal fixed sharing
- sharing according to usage
- sharing according to pledges

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[20] Robert F. Tooper, editor, *Feasibility Study of Computer Resource Sharing*, University of Southern California, unpublished, no date.

Equal fixed sharing requires that each member provide an equal amount of funds for network operation regardless of the level of usage. In an unequal fixed sharing scheme, member payments reflect the usage patterns of previous years and projections of computing requirements. When sharing according to usage, the consortium members are billed at the conclusion of the year according to their level of use. This method assumes that monies are available to meet the day-to-day operational costs of the network. A scheme for sharing according to pledges requires members to project their usage level for the upcoming year and to pledge a dollar amount for purchase of computing services. This method eliminates the cash flow problems created by the sharing according to usage scheme.

A fifth possibility for funding is the "open market" approach. In this system the computing consortium competes with other available computing resources for the computing dollar of network members. Consortium members are free to take their computing dollar wherever the service is best suited to their needs (e.g., commercial time-sharing, other universities). The network competing in the open market will not have a grace period (e.g., a year of prepaid fees) to improve operations; it will tend to offer the services which generate the most revenue.

The final characteristic of organizational structure usually receives the most attention. It is the *configuration of computing.* Computing configuration may be separated into four elements: "hardware" resources, "software development", "support services", and "communications services." Hardware resources and technological configurations were originally the focus of the literature on computer networking. Today, however, emphasis has shifted to include all types of resources. All four computing characteristics are important, and each should be reviewed for appropriateness in light of membership characteristics, desired outcomes, and other organizational components. For example, a centralized approach for developing data processing systems requires an advisory structure and a degree of commitment to the network which decentralized development does not. Membership characteristics often determine the optimal configuration of computing services, and in turn this configuration determines what eventual benefits the network can offer.

Overall, these five dimensions of a consortium's organizational structure are not as distinct and independent as the model may imply. Each component represents a different view of the network's organization. Yet, only when considered together does a complete picture of the network develop. Too frequently networks are discussed in light of only one aspect. To expand our knowledge about implementation, computing professionals must be sensitive to all aspects of organiza-

tional structure. When formulating implementation policy decision makers should consider the interaction of all these dimensions.

OPERATIONAL CHARACTERISTICS

The final component of the structural model includes the operational characteristics of the computing organization (see Table 5.4). These are partly described by the services which the network provides and, in general, may be considered the outcomes of operating the network. These outcomes flow from the demands of members as determined by their membership characteristics and from the organizational structure that influences the operational mode of the network.

TABLE 5.4

Operational Characteristics

Variable	Dimension
A. Actual Services Provided	Single Purpose . . . . . General Purpose
1. Computing Services	
a. Administrative	
b. Academic	
1) Research	
2) Instructional	
2. Other Services	a. Joint Purchasing b. Volume Discounts c. Joint Contract Negotiations d. Etc.
B. User Linkages	Individual . . . Disciplinary/Professional . . . Institutional . . . . . State/Provincial . . . . . National
C. Consortium Goals	Extremely Important . . . Not at all Important
1. Finances	
2. Computing Services	
3. Planning & Coordination	
4. Governance	
5. Institutional Autonomy	
D. Actual Threat to Institutional Autonomy	Low. . . . . High
1. Institutional	
2. Computing Center	

The most basic operational characteristic is the *actual service provided.*[21] For example, the consortium may offer only single purpose "administrative computing" such as batch processing of COBOL jobs, or it may provide general purpose "academic" services such as a terminal system with many different compilers available. Some networks provide "other services" such as volume discounts or joint purchasing agreements. These supplementary services can be important services to the network user.

Services can result in *user linkages* across the network. For example, faculty members in similar disciplines may come together to discuss common research interests, or data processing directors may meet to discuss common recordkeeping problems. These linkages can draw users (e.g., individuals, institutions, states) together, and, as a spin-off of cooperative computing, new communication links may be established.

The *goals* that various member groups hold for the network are also important operational characteristics. In one sense, goals are inputs to the operation of a network, but goals are also formulated as a reaction to current network policy. Thus, particularly at the formative stages of a network, goals may be regarded as outcomes of network activities. At these early stages goals are proxies for measures of network effectiveness.

In an interorganizational setting, goal unanimity cannot be expected. Yet, if different groups are attempting to move the computer network in divergent directions (i.e., have different goals for the consortium), the tension can have a detrimental impact on operation. The priorities which different constituencies possess for the network, as reflected by an assessment of its goals, will provide insights into network operation.

For the purposes of this research five different types of goals have been specified: financial, computing services, planning/coordination, governance, and the institutional autonomy. The first three groupings may be termed product goals since they represent actual products or results for which the network is striving. The other two groups—governance and institutional autonomy—can be termed support goals, for they represent modes of operation which support the attainment of product goals. For example, a network may define as a goal for itself "the involvement of institutions in the policy determination of the network." This governance goal represents a mode of operation that the network intends to utilize in decision-making. As a support goal, it says

[21] This component of the model focuses on the *actual* services which are provided. It stands in contrast to the configuration of computing services (see E in Table 5.3) which is the structure through which these services will be provided.

nothing about the long-term services or products the network hopes to provide. A comparison of goal importance taken across constituency groups can point out inconsistencies and highlight operational issues.

Finally, the establishment and operation of a computing consortium may represent a *threat to the autonomy* of the institutional computer center as well as the institution itself. This threat is a significant operational characteristic. In large measure the level of this threat is determined by the interaction of all the preceding characteristics.[22] It is a culmination of previous events, attitudes, and operational plans for the network. Most importantly, it can impact significantly on consortium implementation. Institutions which feel highly threatened will be reluctant participants and may try to defeat the network. Institutions which feel that the network will preserve their autonomy are more likely to be active, contributing members.

SUMMARY

All four components discussed separately above are obviously interrelated. The impetus to share and the membership characteristics determine, in part, the organizational structure of the consortium. The organizational structure along with the other two components result in the network's operational characteristics.

Yet this model is a static representation of the interrelationship of the structural components. As computer networking matures and more is learned about the cause-effect interactions of these structural components over time, this model can be altered to become a dynamic or process model. Such a theory of implementation would trace the step-by-step sequence of activities and show, for example, how funding patterns may be related to usage or formal structure can influence the level of services provided. In the meantime, an accurate characterization of structure is an important first step. It can provide insight into the effectiveness of implementation and make evident the consequences of policy decisions.

The next chapter applies this perspective to structures of three statewide networks: the New Jersey Educational Computing Network, the Illinois Educational Consortium, and the Minnesota Educational Computing Consortium.

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[22] This component of the model is quite comparable to the institutional autonomy variable outlined in the goals component, yet this component is seen as the actual threat and is the culmination of the interaction of all the characteristics of the network.

CHAPTER 6

Some Operational Hypotheses for Implementation

To characterize implementation, three states have been selected, each of which has established an independent, statewide computing consortia: New Jersey, Illinois, and Minnesota.[23]

In New Jersey, the statewide consortium is the New Jersey Educational Computer Network (NJECN) which has succeeded two previous statewide networks: Educational Information Services (EIS) and the Educational Computing Center (ECC). In Illinois the focus of attention is the Illinois Educational Consortium (IEC). Two regional consortia which fall under the review authority of the IEC, the Mid-Illinois Computing Cooperative (MICC) and the Cooperative Computer Center (CCC), are also mentioned. In Minnesota the statewide organization is the Minnesota Educational Computing Consortium (MECC).

This chapter summarizes the findings from the case studies in sixteen operational hypotheses. For those interested in tracing the detailed history of a particular state, a summary and chronology of events is presented in Appendix B. Readers who want more detailed information are referred to the original research document.[24]

Specifically, the discussion in this chapter has three objectives: 1) to contrast the experiences of the three states; 2) to characterize the inter-

[23] See Chapter 2 for an explanation of the selection of these three states for case studies.

[24] Richard B. Heydinger, "An Exploratory Study of the Operation of Technological Consortia: The Experiences of Three Computer Networks," (Ph.D. dissertation, The University of Michigan, 1976).

relationship among components of the structural model presented in Chapter 5; and 3) to take the first rudimentary steps in forming a theory on the process of implementation. To accomplish these objectives, the experiences and characteristics of the three states are contrasted across the components of the structural model. Whenever clear findings emerge from this analysis, they are stated at the end of the discussion as hypotheses. The terminology "hypotheses" is used to indicate the exploratory nature of this work. While further research would be required to verify these findings, these hypotheses provide a foundation for a working theory of implementation.

THE IMPETUS TO SHARE

As the data from the national survey demonstrate, the impetus to share is created through three interrelated factors: the interventions utilized to bring about statewide planning, the planning process itself, and the degree of participation required of the institutions. This impetus creates the momentum (or lack of momentum) for implementing the state plan.

Interventions

Each of the three states experienced forceful interventions in which the state government formally interceded in computing activities.

In New Jersey, the Department of Higher Education used three forms of intervention to urge cooperation: a moratorium on hardware acquisition, a computing budget freeze, and the disapproval of computing requests from specific institutions. In Minnesota, Governor Wendell Anderson formed a task force to review plans for all state government computing, and at the same time issued an executive order freezing computing expenditures. Later, the Commissioner of Administration was given the power to approve all expenditures for educational computing. Illinois' experiences were comparable, although even more forceful. Expenditures were frozen, an audit of educational computing expenditures was conducted, and a legislative bill was drafted proposing that all educational computing be placed under a state centralized division of data processing although it never passed.

In each of the states, these interventions were instrumental in bringing institutions together to plan cooperative activities. This finding, however, can be placed in a larger context when compared to the findings from the national survey. As we learned in Chapter 4, interventions are *predictors* of planning and implementation, but there is not a direct one-to-one relationship. Some states initiated cooperative activities

without interventions; other states did not establish a cooperative venture even though they had experienced forceful interventions. These cases notwithstanding, the data generally support the important role that interventions can play in leading to the formation of an implementing organization. Also, organizational theorists who have studied *inter*organizational behavior highlight the importance of "some degree of inducement or coercion"[25] to initiate the concerted decision-making process.

> *Hypothesis 1: Forceful interventions on behalf of cooperative computing generally are required for the establishment of an implementing organization.*

Planning Process

The planning process in each of the three states was quite different. In New Jersey the planning for EIS, the state's second network, followed its official formation and was conducted by a blue ribbon panel of in-state representatives and external consultants. In comparison with Illinois and Minnesota, the New Jersey process was brief and the plan was less detailed.

Minnesota's planning efforts involved computing professionals from all constituencies and included powerful figures from the state's Department of Administration. A consultant who had formerly directed the development of the State Universities information system was hired to administer the process and translate the plan into writing.

Perhaps the most instructive planning experiences occurred in Illinois. The process was begun with three large task forces. After they proved to be too cumbersome, authority was assigned to a five-person task force to complete a draft plan. After the initial draft had been critiqued, a panel of institutional presidents assumed the responsibility for designing the organizational structure of the consortium; however, they assigned responsibility for the technological configuration to a task force of computer center directors. The presidents were successful in organizing the consortium, but the computer center directors made little progress on their task. This latter group had no experience in making interinstitutional policy decisions, and they were unable to arrive at a final recommendation for a technological configuration for Illinois.

In all three states, the major planning process included respected and

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[25] Roland L. Warren, "The Concerting of Decisions as a Variable in Organizational Interaction," in *Interorganizational Decision Making*, edited by Matthew Tuite, Roger Chisholm, and Michael Radner (Chicago: Aldine Publishing Co.), 1972, p. 27.

knowledgeable individuals. Although each planning committee utilized outside consultants, each also involved persons who were intimately familiar with the local situation. Most importantly, each of the states' planning groups included individuals whose perspective was broader than a single institution. For example, in New Jersey and Illinois a representative from the coordinating/governing board was on the planning committee. Planners who had institutional affiliations had experience either in functioning at the policy level (i.e., presidents) or in guiding other cooperative arrangements.

> *Hypothesis 2: If a new computing organization is to be established, individuals must be involved in the planning process who have the authority and the experience to make institutional policy decisions and who have interests beyond the domain of the individual participating institutions.*

Degree of Participation Required

While it is difficult to characterize their experiences unequivocally, the institutions in all three states were encouraged by an "invisible hand" to participate in networking. This guiding force was provided by state government and/or statewide coordinating boards. Formal interventions by these external parties made it unmistakably clear that cooperative computing was a good idea. Yet, in both New Jersey and Illinois, the major state universities were able to avoid facility management contracts initially. Although participation as "members" of the network was a *fait accompli,* actual participation in sharing was contested successfully. Specific issues related to participation were often vigorously argued, for they focused on the critical issue of institutional autonomy. Depending on the evolution of these consortia, these issues may come to the fore again.

> *Hypothesis 3: Directed sharing may lead to the* establishment *of an implementing organization, but it does not guarantee active or total participation by the members in the network.*

In summary, the characteristics that describe the impetus to share in these three states are different but have common themes. Strong interventions, planning processes that involve internal and external experts, and an "invisible hand" mandate to participate describe each state. Although similar implementing organizations were established, the impetus to share is qualitatively different in each of the states. Interventions utilized in Minnesota were not viewed with the disdain that

they were in New Jersey and Illinois. The planning process in Illinois lacked the participatory spirit which characterized Minnesota. Although the planners did not solely create the impetus to share, they might have taken special steps to promote a more favorable impetus toward sharing if they had recognized its causal link with successful implementation. In fact, New Jersey and Illinois lacked the impetus which characterized Minnesota. This difference in impetus to share was further reinforced by the membership characteristics of the consortia which is the focus of the discussion in the next section.

MEMBERSHIP CHARACTERISTICS

To a large extent, a computing consortium must adapt to the characteristics of its members. They are the givens which the consortium must accept, and with which implementation policies should be consistent.

Number of Members, Geographical Distribution, and Diversity

The broadest range of membership belongs to MECC, the Minnesota consortium, which includes not only the postsecondary educational systems but also all public school districts in the state. MECC is broadened further by the large geographical area of the state. These expansive characteristics are balanced by the concentration of population and government offices in the Twin Cities area in which St. Paul is the state capital and Minneapolis the state's largest city. With all education and government offices in the same metropolitan area, joint meetings could easily be held.

The Illinois consortium, IEC, lacks the centralizing forces that characterize Minnesota even though the state is smaller geographically. The University of Illinois, the state capital, and the population center of the state are each in different locales. Moreover, Illinois' large population and the size of the educational systems make centralized cooperation extremely difficult. Although membership in IEC has been limited to the four senior educational systems, this educational community is larger and more diverse than Minnesota's senior educational system.

New Jersey offers a third point of comparison. Membership in the New Jersey consortium, NJECN, includes *all* postsecondary institutions; and although some services are provided to secondary schools, they are not formal members. Relative to its population, New Jersey is a moderate size state and has a small higher education system.

These three states represent a mix of membership characteristics. MECC is a set of counteracting forces—a diverse membership clientele that is pulled together by the Twin Cities area. The Illinois consortium, IEC, although smaller geographically, links a complex system of systems. NJECN has the greatest number of positive membership characteristics which reinforce cooperation; but, as experience has shown, these characteristics are balanced by a negative impetus to share.

Certainly there is no unique combination of number, geographical distribution, and diversity of members that is required for implementation. Yet, if a consortium is to be established, factors that mitigate against cooperation must be overcome. Extreme size, although providing certain economics of scale, can be a negative influence on implementation. For example, a consortium comprised of a large number of members requires a level of coordination that is not necessary for smaller consortia. Extended geographical distribution results in increased communication costs and increased difficulty in holding face-to-face meetings. If membership includes a diverse set of educational institutions (e.g., community colleges and major universities), each may view computing issues quite differently. Certainly such factors are not insurmountable, but these potentially negative forces must be overcome if implementation is to occur.

Hypothesis 4: There is no unique combination of membership characteristics required for successful implementation.

Hypothesis 5: Membership characteristics that work against cooperation must be overcome if implementation is to occur.

Corollary: Extreme breadth of membership is characterized by large number of members, wide geographical distribution, or diverse types of institutions will mitigate against cooperation.

Computing Environment

The differences in computing environments point to some critical distinctions in implementation policy. In all three states the major university possesses the most sophisticated hardware and the most computing expertise. Here, however, the similarity ends.

In New Jersey the state and community colleges had not developed their own expertise, nor did they possess a significant amount of hardware. Generally, these institutions can be characterized as "have-nots." In contrast, Rutgers possessed both computing expertise and computing

power. This environment suggests a star network located at Rutgers with the "have-not" state and community colleges accessing the central facility. Such a configuration builds on the existing computing environment.

In Illinois although the state colleges had acquired their own resources and developed their own expertise, the University possesses a vast array of instructional hardware and the state's largest administrative data processing installation. This environment suggests two alternatives. The powerful facilities at UI could be brokered to augment the existing computing capabilities at the other state institutions, or the state colleges could pool their expertise (and hardware) to establish their own cooperative center.

In Minnesota, the state colleges, community colleges, vocational-technical institutes, and public schools had each developed some type of cooperative center. Thus, during the planning process, each of the constituencies possessed some self-confidence as well as computing expertise. This computing environment suggests a myriad of alternative configurations. The state's existing time-sharing networks could be expanded to offer services to all MECC members. A distributed network linking the variety of sophisticated installations could be attempted. Alternatively, each of the educational systems could build on its unique expertise and establish independent centers.

Each of the alternatives suggested above is harmonious with the existing computing environment and builds on it. Cooperative configurations that run counter to the existing computing environment are self-defeating since they erect additional obstacles to implementation.

> *Hypothesis 6: Implementation should build on the computing environment of member institutions rather than run counter to it. Existing expertise and available hardware of network members should be utilized within the consortium configuration whenever feasible.*

Previous Cooperative Ventures

The impact of previous cooperative ventures on the formation and operation of these consortia cannot be over-emphasized. In Minnesota, a series of regional hardware sharing and system-wide planning activities had taken place. For the most part these activities had been successful in accomplishing their original purposes, and, simultaneously, they laid valuable groundwork for the formation of MECC. As a result, educational institutions in Minnesota recognized themselves as interdependent participants in the system of statewide educational computing. Secondly, through these early cooperative ventures, individuals became

acquainted with others in the various systems and with the problems and work styles of other systems. This history of cooperation paved the way for the transition to MECC; and as one respondent said, "Statewide planning seemed like the next logical step."

Illinois and New Jersey did not have a history of successful cooperative efforts. Prior to the reconstitution of NJECN, New Jersey had established two statewide networks, both of which had mixed success. Nevertheless, even these somewhat unsuccessful efforts made a positive contribution to NJECN for each new network eliminated some of the operational problems of its predecessor.

Illinois' previous cooperative efforts were limited to one significant experience, the establishment of the Board of Governor's Cooperative Computer Center in the Chicago area. This regional center was a mixed success, and because of its limited scope, these experiences provided little guidance in the formation of the statewide consortium. Thus, Illinois embarked on statewide planning without the benefits of previous cooperative ventures.

In summary, the momentum which had been created in Minnesota was absent in both Illinois and New Jersey. Consequently, implementation in these two states was more problematic. Previous cooperative ventures are not the *sine qua non* for successful implementation. However, in the absence of previous successful cooperative efforts, commitment to cooperative computing must be built. Cooperative statewide computing cannot simply be legislated. If implementation is to be effective, strategies must gradually build a cooperative attitude.

> *Hypothesis 7: For effective implementation to occur, a cooperative attitude toward computer sharing must exist. Previous cooperative ventures, particularly those which are regarded as effective, can build the requisite cooperative attitude.*

ORGANIZATIONAL CHARACTERISTICS

The organizational structure of these three networks reflects the different approaches each state has taken. A separate examination of each major component of the organization delineates some critical issues for implementation.

Domain

Recall that we have defined the domain of an organization to include its relationship with other organizations and its scope of responsibilities. NJECN serves all public postsecondary computing,

both academic and administrative. Activities are limited to computing, and, in fact, the consortium provides all aspects of computing service. MECC serves all public education computing and maintains relationships with some organizations in the private sector. In Minnesota MECC may provide a full range of computing services either by brokering the services of other organizations or, where appropriate, by operating its own facilities. Illinois' IEC serves only the four senior systems of higher education, but its purposes have been expanded to include the support and advancement of "collective activities of institutions . . . as a means to improved *management.*"[26] Thus the domain of IEC is most narrowly defined in terms of members, but it is the most expansive with regard to purposes. Computing service is only one of the products of the consortium. IEC coordinates and facilitates many advantageous financial arrangements for members. The consortium may, but is not required to, take an active role in the operation or provision of computing services.

Formal Structure

Upon cursory analysis, the formal structures of these three consortia appear quite similar, but a second examination shows that they are quite different. All three statewide cooperatives exist as autonomous organizations. MECC was formed under the Joint Powers Act, a legislative act that permits any state agency to transfer a portion of its authority to a second organization. NJECN and IEC are not-for-profit corporations.

Each consortium has a board of directors made up of representatives from member constituencies; but, each state selects its board somewhat differently. Illinois' eleven-person board includes eight voting members, two from each senior system of higher education. Private education, the community colleges, and the Board of Higher Education each have a single non-voting board member. MECC has a sixteen-member board with six members representing elementary-secondary-vocational schools and six members representing higher education. Three appointments (one of which customarily includes a representative from higher private education) are made by the Governor. The final member is appointed by the Department of Administration. In contrast, representation on New Jersey's twelve-member board is partially determined by the financial pledges of its principal members. For example, if an institution's pledge represents fifty percent of the dollars committed to ECN, then this institution is allowed to select six directors (one-half of total board

[26] Emphasis added; Article I, p. 1, Revised By-Laws of the Illinois Educational Consortium, 11/4/74.

membership). Thus, constituency representation may change from year to year. Consortium members who are not designated in the by-laws as principal members are guaranteed board representation through network usage.

The level of involvement by the state government and the coordinating/governing agencies on all the consortium boards is worth noting. In Illinois and New Jersey the state governing board has been specifically excluded from voting membership. This structure was negotiated as a compromise during the establishment of these two consortia. In both states people who were interviewed indicated that this was done to prevent further erosion of the institutions' freedom in conducting their own operations. With the formation of MECC, Minnesota's coordinating board has divorced itself from the affairs of computing and does not have a board seat. Yet, the powerful Department of Administration has a single board appointment, and the Governor has three appointees. Although in each of the states the government has some designated role, the negotiated non-voting authority in Illinois and New Jersey attests to the intrusion perceived by institutions into their affairs.

It is interesting to compare these findings on implementation with the data on planning. The national survey attests to the active role which coordinating/governing boards play in initiating cooperation. State intervention is a powerful force in bringing the institutions together, and state representatives are major contributors to the planning activities. At the implementation phase, their decreased role reflects a desire on both the part of the state and the institution to remove the state government from the operation of the network. Sometimes this is done willingly; in other cases it becomes a compromise issue.

The size and structure of consortia staffs highlight their fundamental purposes. Both MECC and NJECN have large staffs (see Table 6.1) in order to provide many operational services. IEC, acting in the role of coordinator and facilitator, has a President and one other professional staff member. Each consortium has an extensive committee and advisory structure. The impact of these committees and the actual governance by the board of directors is discussed in the next section.

> *Hypothesis 8: The coordinating/governing board, although playing an active role in planning, will assume a much less active role in the implementation of the network.*

TABLE 6.1
Organizational Structure of the Consortia

M.E.C.C. (MINNESOTA)	N.J.E.C.N. (NEW JERSEY)	I.E.C. (ILLINOIS)
Board of Directors: 16 members –6 representing higher ed. –6 representing elementary, secondary, vocational –3 appointed by governor –1 appointed by Commissioner of Administration *Committees:* –Advisory Council - 16 members, advises executive director –User Advisory Committee –Technical Advisory Committee *Organization of Consortium Staff:* 3 functional services areas –Instructional Services Div. –MIS Division –Research & Development Div. *Staff Size:* Approximately 35	*Board of Directors:* 13 members –12 selected by percentage dollar amount each membership sector commits of the total financial pledges –1 non-voting, appointed by Chancellor of Higher Education *Committees:* –Committee of Presidents; formulates commitments to network budget; 4 members - Presidents of Rutgers, College of Medicine and Dentistry, and two State Colleges –Planning and Technical Committee; reviews technical planning functions and provides checks and balances to the management of the network; 9 members –Center Directors Advisory Committee; policy advisory body of data center directors of institutions; 9 members –Academic Technical Committee; acts as a high level users committee from across the academic disciplines; 12 members –ADP Technical Committee; users committee of administrative users; 8 members –Systems Group; reviews technical proposals from all other committees and from management; 10 members *Organization of Consortium Staff:* Organized into five departments –Operations and Systems –Academic Services –Administrative Data Processing Services –Planning –Administration Staff Size: Approximately 65	*Board of Directors:* 11 members –2 members from each of four systems –3 ex-officio members Community College; Private Institutions; Board of Higher Ed. *Committees:* –Purchasing Advisory Council –Director's Advisory Council *Staff Size:* President of the Consortium

Consortium Governance

Major policy decisions in all three consortia are executed officially by the board of directors. As one might expect, however, consortia staff actually play a major role in developing the agenda and the issues to be discussed. Member institutions contribute to policy determination at different levels in each consortium. As Table 6.2 shows, influence levels vary widely across the various membership constituencies.

Note that, across all three states, the influence exerted by any single constituency is fairly consistent, and all differences are easily explained. Each of these consortia is dominated by the state's major public university and, with one exception, by the consortium's executive director.[27] In each of the states, the state colleges are perceived to have considerable influence but are, in fact, not nearly as influential as the major university. This discrepancy is most pronounced in New Jersey where Rutgers is perceived as the heavily dominant party in network policy.

The community colleges, secondary schools, and private institutions exhibit varying levels of influence that can be explained by examining the specific structure and experiences of the consortium. In Minnesota secondary schools represent the largest potential user group. They have been active in consortium affairs and are perceived to exert nearly as much influence as the University of Minnesota. This bifurcation of influence is an interesting split. The secondary schools are apprehensive of the University's expertise and prestige while the University is fearful of the clout that the public schools, with their vast number of districts, can exert in any political showdown.

The impact of the governmental constituencies also varies across the states. In New Jersey and Illinois the governing boards are powerful forces, and the board/department of higher education is perceived as having considerable influence. This is interesting in view of the fact that neither one has an official seat on the consortium board. Probably this reflects the continuing presence of the "invisible hand" and vestiges of the active role which these agencies assumed in initiating cooperation. In Minnesota, since the powerful Department of Administration (grouped with the executive branch of state government) has been actively involved in implementing the state plan, this group is perceived to have considerable influence.

From these data on influence three major findings emerge. First, each of the consortia is dominated by the state's major university, even

[27] At the time of data collection New Jersey was in the process of hiring a new executive director. Undoubtedly this "lame duck" tenure is reflected in these figures. In no way should these be construed as representing the current administration.

TABLE 6.2

Perceived Influence on Consortium Policy Decisions
(all figures are group means)

	New Jersey (N = 14)	Illinois (N = 12)	Minnesota (N = 23)
Consortium:			
Consortium Executive Director	2.8	1.6	1.7
Consortium Staff	2.5	N/A	2.3
Institutions:			
Major Public University	1.2	1.3	1.9
State Colleges	2.3	2.2[a]	2.5
Community Colleges	3.6	4.3	3.1
Vocational Schools	b	b	2.8
Secondary Schools	4.8	4.9	2.0
Private Educational Institutions	3.2	4.0	3.7
State Government:			
Coordinating/Governing Board	1.9	2.2	4.0
Executive Branch of the State Government	3.1	3.7	2.0
Legislative Branch of the State Government	3.7	3.3	2.7
Outside Consultants	4.3	4.1	4.2

Scale: 1 = a *great* deal of influence
2 = *considerable* influence
3 = *some* influence
4 = *little* influence
5 = *no* influence

Notes:

[a] This mean is a combination of influence levels for Southern Illinois University, Board of Regents, and Board of Governors' Institutions.

[b] Vocational schools were grouped with secondary schools in this state.

in Minnesota and Illinois where these institutions have not been the primary recipients of cooperative services. Second, the "pecking order" of influence of various institutional constituencies is consistent across the three states. This "pecking order" deviates little from the informal prestige rankings in American education in which major universities appear at the top followed by state universities, four-year colleges, and community colleges. Third, the relative influence of the state government on the policies of the consortium is dependent on its assertiveness and involvement in network affairs, regardless of whether the state government has formal input into consortium policy. These findings, drawn from the case studies, are consistent with similar data collected in the national survey.

Hypothesis 9: Regardless of their level of involvement in sharing activities, major state universities exert the most influence on consortium policy decisions.

Corollary: Relative influence on network policy decisions is closely aligned with the informal prestige ratings for different types of institutions.

Hypothesis 10: The relative level of influence of the coordinating/governing board on policy decisions is a vestige of the role which it played in planning the network; also contributing to the board's influence is the authority (i.e., potential) it possesses for intervening in network affairs.

Funding

Each of the consortia is financed quite differently, and a comparison of the three approaches is instructive. MECC sells its services to member institutions. Although state appropriations are not specifically identified to be spent on MECC, the consortium has the power to review all state computing expenditures. Therefore MECC can make sure that any new computing resources will be consistent with its plans. For the first two years of MECC's operation the state legislature established a revolving account of $150,000. This permitted the consortium to meet its cash flow requirements and provided operating capital. During the first two years of MECC's operation, educational systems have promptly paid off their debts to MECC for services rendered, thus providing additional operating funds for the consortium.

IEC charges its four systems an annual $15,000 membership fee. The systems in turn assess each institution a proportionate share of this fee. This fiscal policy guarantees the consortium a $60,000 operating budget and permits detailed financial planning.

New Jersey's funding system has been more problematic. Under EIS, the state's second utility, institutions were billed for the services they used; however, unlike Minnesota institutions, these members did not meet their debts. Thus, EIS staff was preoccupied with the problems of meeting payrolls and having enough capital to continue operations. Under the new (third) structure of the network, NJECN has attempted to alleviate these problems by annually requesting principal members to pledge a dollar amount that reflects the relative level of services they expect to purchase in the upcoming year. This provides a more stable funding pattern and from it detailed financial projections can be drawn.

From these funding experiences some important findings emerge. First, for effective network operation, a stable financial base must be guaranteed. Without such a base, as experiences in New Jersey have shown, consortium staff find themselves preoccupied with fiscal policy rather than network implementation. Second, some method must be devised to cover developmental costs. The revolving account (Minnesota), the special state appropriation (MICC in Illinois), the foundation grant (ECC in New Jersey), or the donation of time and resources (IEC in Illinois) are all viable possibilities. Network planning must carefully address this aspect of implementation. Third, the long-range implications of funding strategies should be debated. Since most networks are relatively young, the impact of various funding schemes is unknown. Nevertheless, various scenarios ahould be discussed. For example, MECC has equal representation across all systems on the board of directors; yet, MECC will be funded according to usage. If, over time, a specific system emerges as the primary user (and thus fundor) of MECC services, will that system begin to demand a larger voice in network policy decisions? In contrast, if a pledge system is used, as in New Jersey, what happens when an institution uses less services than it pledged to purchase? Is an institution that uses more than it pledged liable for additional payments? In general, what impacts on usage patterns does a buy-as-you-go system have compared to a pledge system? The questions are not unanswerable, but they must be debated. To implement an effective network, funding policies must provide a stable financial base and be consistent with other structural components.

> *Hypothesis 11: The development of a consortium needs special, one-time funding arrangements to guarantee initial operation. Continued network operation demands a stable financial base from which detailed financial projections can be made.*

Configuration of Computing

New Jersey's three successive networks have been star nets with the central site computer residing at one of the major universities—Princeton or Rutgers. Since the other institutions in the state possessed relatively little computing expertise and hardware, the adoption of a star system seems quite consistent with membership characteristics. NJECN provides centralized hardware and software services through an IBM 370/158 and an IBM 370/168. As demand grows it seems unlikely that New Jersey will find it advantageous to opt for another configuration.

Minnesota has adopted an eclectic approach to providing services. Each computing need is examined across all user populations to determine the optimal configuration. For academic time-sharing MECC has attempted to establish a statewide, centralized network. For administrative data processing, each educational system has continued with its own developmental plans. For example, the public school system has adopted a MECC-coordinated, regional approach.

In Illinois the IEC is an umbrella organization for a hybrid set of cooperative activities. Currently the state has: 1) the regional Cooperative Computer Center which services three Board of Governors' institutions; 2) the Mid-Illinois Computing Cooperative that serves five institutions across three educational systems; and 3) the University of Illinois' centralized Administrative data processing facility which serves all three of its campuses. Although the Illinois plan implied the establishment of a more centralized configuration, this hybrid approach evolved after unsuccessful negotiations to broker the University of Illinois resources. The Illinois configuration seems to be a response to the political realities of the state and to the barriers to centralization in a large, complex state. The hardware of the major university remains independent while all but two of the other state universities are involved in some type of cooperative arrangement. The community colleges have some access to UI facilities, but they also remain independent.

Thus, each of these states has opted to handle computing services in a different manner. From this limited set of experiences one may conclude that stability cannot be achieved until the computing configuration adequately matches the membership characteristics.

> *Hypothesis 12: Although no single hardware configuration is best for educational networks, network stability in the form of effective services rendered to a maximum number of members will not be attained until the hardware configuration adequately matches membership characteristics.*

In conclusion, a final tangential thought on hardware configurations seems in order. Currently, it is in vogue to say that the problems of networking are not technological but rather political, organizational, and economic.[28] Yet the technology of networking is the backbone of cooperative computing. Without effective technological linkages, networks are doomed to fail. Although all of these consortia are still young, a large part of their success will depend on how efficiently and effectively they can implement the technological aspects of their networks.

OPERATIONAL CHARACTERISTICS

From the impetus to share, membership characteristics, and the organizational structure flow the operational characteristics of the computing consortium.

Actual Services Provided

The three computing consortia vary in the services they have provided. In New Jersey the three successive networks all provided computing resources to the public institutions. ECC provided access to computing for at least twenty-three postsecondary institutions and a number of secondary schools through both the Princeton and Rutgers computing centers. The second network, EIS, provided satisfactory academic hardware and academic support services to the same institutions. Although EIS administrative services were more problematic, after a number of false starts, EIS also provided administrative computing services to some state colleges and county colleges.

In retrospect, EIS services were plagued by three problems. First, there was the continual issue of Rutgers' autonomy and the institution's relationship to the network. Second, EIS did not have the financial support necessary for a young organization to develop. Because network leaders were distracted by financial problems, they could not design systems and improve services. Third, day-to-day services were problematic because of the instability of Princeton's configuration of the IBM 370/158 - 360/91. It took an extended period of time to shakedown the dual computer configuration. Moreover, the operational staff at Princeton was not always responsive to network concerns.

The third New Jersey network, NJECN, provides both academic and administrative services through the network computing center located

[28] Martin Greenberger et al., editors, *Networks for Research and Education* (Cambridge: MIT Press, 1974), p. 22.

on the Rutgers campus. The system is a dual configuration of an IBM 370/158 and an IBM 370/168, both owned and operated by NJECN.

In Illinois, the computing consortium does not operate any computing facilities. Instead, the consortium purchases hardware which it then leases to state institutions and regional centers.

The consortium also facilitates the "trading up" of hardware from one institution to another. For example, if one state school is going to upgrade its computer, IEC can act as an agent in transferring this older machine to another institution that can use this hardware. Through this support service, IEC has facilitated the expansion of computing in a cost-effective manner.

IEC also "support(s) and advance(s) the collective activities of institutions of higher education in the state of Illinois as a means of improved management." Obviously, this new charter (amended in 1975) significantly expands the scope of authority of the consortium. Under IEC, member institution purchasing agents have formed an organization (Purchasing Advisory Council) to negotiate volume discounts for different types of goods and services.

In Minnesota, MECC provides computing services in a number of different areas. The most visible and controversial service was the negotiation, installation, and finally the return of a UNIVAC 1110 system. This machine was installed in August, 1975, to provide instructional time-sharing services for much of the state through its 300 port capacity. Dissatisfaction with its effectiveness and lingering doubts about the wisdom of a central, statewide academic time-sharing machine led to its return, before final acceptance, in October, 1976. During this fourteen month period, however, this system did provide services to many users who previously had no access to computing resources.

Since 1974, MECC has also offered an extensive series of user workshops on instructional computing. These provide potential users of MECC services with a growing awareness of the consortium, and the workshops educate users to the capabilities of instructional computing. Individual participants who were interviewed communicated a sense of accomplishment. These workshops seem to be an effective tool for building an awareness of MECC and instructional computing.

MECC administrative computing services are in the planning stages. Through the Management Information Division, plans have been completed for the development of regional data processing centers at the elementary-secondary level. In late 1975 a contract was signed with Burroughs to purchase B-6700's and B-1700's as these regional ADP machines.

From this review of actual services provided, no operational hypothesis can be proposed. Nevertheless, some general observations are possible. As these networks demonstrate, there is a limitless variety of configurations for providing hardware and support services. Workshops can increase people's awareness about the consortium and expand their horizons with respect to computing.

The experience of all three of these states demonstrate that plans are usually implemented neither as quickly, nor as effectively, as originally envisioned. Most significantly, the experiences of these states reinforce the importance of having a computing configuration that addresses the specific needs of consortium members.

User Linkages

The implementation structures in all three states resulted in comparable user linkages. The process of planning and then establishing an interinstitutional organization draws together parties that previously may not have been in contact with each other. In all three states users cited as one of the primary accomplishments of the network the common awareness, the forum, or the linkages that occurred as a result of network activities. Institutional representatives are now aware of each other's problems. They now better understand each other. Consequently, as a group they can present a more unified picture of their needs to the state government.

> *Hypothesis 13: Statewide computing consortia establish a common awareness across institutional members of each other's strengths, weaknesses, and challenges. These newly established relationships are frequently one of the major initial accomplishments of computing consortia.*

Consortium Goals

The following analysis of goals aggregates data collected across the three states. As part of each case study interview respondents were requested to complete a survey that evaluated the importance of twenty-three possible consortium goals.[29] The most significant findings from that survey are presented here as comparative goal rankings as determined by the mean importance assigned by each of four constitu-

[29] See Chapter 2 for an explanation of the method used to construct this goals survey.

ency groups: the consortium staff, the state government, the major university, and the institution/system.[30] Recall that according to the structural model presented in Chapter 5, consortium goals are grouped into five categories: finances, computing services, planning and coordination, governance, and institutional autonomy.

Table 6.3[31] portrays vividly the differing priorities that these four constituencies assign to consortium goals. As might be expected, the state government[32] and consortium staff both rank the planning and coordination goals high on their importance list, while the institutions' representatives (including the major universities) are concerned with governance and institutional autonomy. The major question is, "What implication do these differing priorities have for network implementation?" A review of the responses from each constituency provide some clues.

To the consortia staffs (see Column A in Table 6.3) the most important goal is planning for the systematic expansion of computing services (goal #23). Nearly equal in importance is implementing the statewide computer plan (#19) and establishing an organization that is responsive to institutional needs (#18). Providing cost-effective services (#2) and an equal opportunity to access computing (#6) are also regarded as extremely important. In general, these staffs view a large number of goals as very important and rank a cross section of goal types as the most important.

State government respondents are characterized by the noticeable exceptions in their goal ratings compared to those of other groups. Like respondents from other constituencies, the state government respondents rate cost-effective computing (#2) and responsiveness to institutional needs (#18) as being important. However, in contrast to the other constituencies, state government respondents rank several financial goals as very important: slowing the expansion of computing budgets (#1), providing a mechanism for controlling dollars spent (#5), promoting the comparability of institutional data bases (#21), and

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[30] This category includes responses from all institution and system representatives except those affiliated with the major university system.

[31] Note that the measure presented in Table 6.3 weights each of the states equally by taking a mean of the means. This approach was used because the number of responses varied significantly among states, and a grand mean would have given the state with the most responses the greatest weight. Since this is a characterization of *state* rather than *individual* perceptions, a mean of the means was required.

[32] This constituency includes both education and non-education agencies. For example, respondents from the statewide coordinating/governing board are included here as are representatives from the legislative branch of the state government and executive agencies.

TABLE 6.3
Importance of Goals by Constituency Across All Three Case Study States

GOAL STATEMENTS	A Importance of Goal to Consortium Staff		B Importance of Goal to State Government		C Importance of Goal to Major University		D Importance of Goal to Institution/System*	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Financial:								
1. To slow the expansion of computing budgets at the institutional level	3.9	21	2.0	8	3.7	20	3.1	18
2. To provide cost-effective computing services to institutional users	1.3	4	1.2	1	2.1	6	1.5	2
3. To offer computing services to institutions at the cheapest possible cost	2.0	11	2.0	8	2.9	15	2.0	9
4. To equalize the amount of money spent on computing at each institution	4.3	23	3.8	22	4.1	22	3.7	21
5. To provide the state government with an effective mechanism for controlling the total dollars spent on computing	3.7	19	1.7	6	4.1	22	3.1	18
New Computing Services:								
6. To provide all institutions with an equal opportunity to access appropriate computing resources	1.3	4	2.0	8	2.4	10	2.1	11
7. To provide access to sophisticated operating systems, programming languages, and data bases that most individual institutions could not support or maintain	1.5	8	2.0	8	2.4	10	1.6	4
8. To foster the growth and development of computing expertise at the institutional level	1.4	6	1.5	3	2.7	14	2.0	9

* "Institution/System" includes respondents at both the institutional and the single system level (e.g., community colleges, four-year state colleges).

Continued

TABLE 6.3 (Continued)

GOAL STATEMENTS	A Importance of Goal to Consortium Staff		B Importance of Goal to State Government		C Importance of Goal to Major University		D Importance of Goal to Institution/System*	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
New Computing Services (Continued):								
9. To establish a statewide computer network that will serve as a national model	3.1	18	3.2	21	3.3	17	4.0	22
10. To distribute software packages that are developed at one institution to other potential users in the state	2.0	11	2.0	8	2.4	10	1.9	8
11. To limit the service responsibilities of _____ to areas of general purpose computing	3.9	21	2.8	18	2.3	9	4.1	23
12. To insure that no user of computing suffers any decline in the level of type of service as a result of joining _____	2.8	16	2.3	15	1.6	1	1.8	7
Institutional Autonomy:								
13. To preserve the independence of institutional computing centers	3.7	19	4.0	23	1.7	2	2.3	13
14. To establish _____-owned and -operated installations which would provide computer services to educational institutions	2.9	17	2.8	18	3.8	21	3.4	20
Consortium Governance:								
15. To involve the institutions in the decision-making and policy determination of _____	1.4	6	2.5	16	1.7	2	1.6	4
16. To establish an open channel of communication between educational institutions and the state computer organization	1.6	9	2.5	16	2.0	5	1.6	4

17. To allow users to define the type and level of services most needed	1.6	9	2.0	8	2.1	6	1.4	1
18. To establish a statewide computing organization which is responsive to institutional needs	1.2	2	1.3	2	1.9	4	1.5	2
Coordination and Planning:								
19. To implement the statewide, educational computer plan	1.2	2	2.0	8	2.6	13	2.5	14
20. To present to the state government a unified voice for educational computing	2.0	11	2.8	18	3.1	16	2.2	12
21. To promote the compatibility and comparability of institutional data bases	2.4	15	1.7	6	3.3	17	2.9	17
22. To coordinate and control the growth of educational computing in the state	2.3	14	1.5	3	3.3	17	2.6	15
23. To plan for the systematic expansion of computing services in the state	1.1	1	1.5	3	2.2	8	2.7	16

Importance Scale:
1 = *Extremely* Important
2 = *Rather* Important
3 = *Somewhat* Important
4 = *Of Little* Importance
5 = *Of No* Importance

*"Institution/System" includes respondents at both the institutional and the single system level (e.g., community colleges, four-year state colleges).

+At the time data were collected, the name of the state's network was inserted here.

coordinating and controlling the growth of educational computing (#22). This group also rates two governance goals (#15 and #16) as noticeably less important than does any other constituency.

The major university respondents offer yet another perspective on goal rankings. In contrast to other groups, these respondents generally assign lower rankings to consortium goals with only five goals having a mean importance rating of at least 2.0. To the major university the most important goals are ones that preserve the status quo: insuring that no user suffers any decline in computing services (#12), preserving the independence of institutional computing centers (#13), involving institutions in decision-making (#15), and establishing an organization which is responsive to institutional needs (#18). The major university usually has little to gain from participating in the consortium and much to lose.

Like their major university counterparts, the institutional/system respondents rate governance goals as very important. However, they are less concerned about issues of institutional autonomy and somewhat more concerned about new computing services. As a group, this constituency will experience more tangible benefits from an effective network. Their goal prioritization reflects an expectation of benefits.

In summary, from these comparisons and other data emerge a relatively detailed picture of the different outputs that various constituencies seek (see also Table 6.4). State governments seek mechanisms for slowing expansion and coordinating growth. Major universities seek to preserve the status quo and prevent the further erosion of institutional autonomy. State colleges/universities and their system heads, although concerned about consortium governance, also value the new services that a network can provide. The network staff seeks a variety of goals which reflect the many different publics that it must serve.

These findings should come as no surprise to those who are involved with computer networks, yet a verification of basic folk wisdoms assures one that assumptions are accurate. More importantly, this quantitative representation of the network environment reveals the tensions inherent in a consortium. Goal unanimity is not present. Each constituency values a different set of outcomes; thus, each group is seeking something different from the network.

> *Hypothesis 14: Institutional members of consortia rank goals on network* governance *as being significantly more important than goals on institutional autonomy, new computing services, or coordination/planning. In contrast, network staff view the* coordination and planning *for the systematic expansion of computing as being extremely important.*

TABLE 6.4

A Summary of Goal Priorities by Constituency

	Consortium Staff		State Government		Major University		Institution/System	
Type of Goal	Average* Mean	Average Rank	Average* Mean	Average Rank	Average* Mean	Average Rank	Average* Mean	Average Rank
Financial	3.0	15.6	2.1	9.0	3.4	17.0	2.7	13.6
New Computing Services	2.3	12.0	2.3	11.6	2.4	10.1	2.5	12.0
Institutional Autonomy	3.3	18.0	3.4	20.5	2.7	11.5	2.8	16.5
Consortium Governance	1.4	6.5	2.1	10.5	1.9	4.2	1.5	2.8
Coordination and Planning	1.8	8.6	1.9	7.6	2.9	14.2	2.6	14.8

Importance Scale:
1 = *Extremely* Important
2 = *Rather* Important
3 = *Somewhat* Important
4 = *Of Little* Importance
5 = *Of No* Importance

*All three states have been weighted equally by taking a mean of the means.

Once the computing cooperative has come into existence, will the fundamental differences in goal outlook immobilize the consortium? Some speculations can be proposed. When goals diverge across constituency groups, instead of cooperative decision-making, contest processes result. Also, when decisions are viewed differently by different groups, a negotiation process can become an adversary one. At the time that these three consortia were studied, a divergent goal structure characterized the member constituencies. Yet at that time these consortia were working for a similar goal, namely, the establishment of the computing cooperative.

In this discussion, two theoretical concepts are important. First, the "payoffs" or benefits which each constituency receives from any decision must be assessed. Second, any threatened decrease in the domain of a constituency will meet with strong resistance. Thus, if a proposed consortium decision (e.g., delivering a new computer service) offers a positive payoff to a group of institutions (e.g., state colleges) without decreasing the domain of another (e.g., the computing services of the major university), then the consortium will probably reach a decision and implementation will follow. Few consortium decisions are so straightforward. Usually some constituencies benefit while others are threatened.

In complex situations, the relative likelihood of various proposals being enacted will be determined in part by the influence patterns of the consortium. As we have seen, the major universities dominate these consortia. If the major university wields the most influence, then the payoff for the university must at least be non-negative for a decision to be made. In New Jersey the payoff to Rutgers for finally becoming an active part of the network was to receive a significant hardware upgrade. In Illinois, the major university has become separated from the computing services of the other institutions. However, the University of Illinois receives positive benefits from IEC including low cost leasing agreements and purchasing discounts that would be impossible without the consortium. In Minnesota, the University receives few if any positive benefits directly from MECC.

Thus, when the influence patterns are related to the different goal priorities, the future ability of these consortia to make decisions is unclear. The parties with the most influence, the major universities, want to move cautiously and slowly with regard to cooperative computing services for they have little to gain from these cooperative ventures.

Hypothesis 15: The likelihood of a policy being enacted will be determined by the payoff to the more influential

constituencies within the consortium. The proposal that is ultimately chosen must have at least a non-negative payoff to the most influential constituency.

One final comment on goal priorities is important. As Table 6.4 shows, member representatives from these three consortia ranked the governance goals as the most important. New computing services, although "rather" important, were not viewed as important as governance. In other words, the way in which these consortia governed themselves received a stronger, more unanimous endorsement than did the types of new computing services provided. Comments made in the interviews also highlighted the importance that people place on *how* these new networks function. If the governance goal is not addressed, it can inhibit implementation. For example, in New Jersey's second network (EIS) institutional users were skeptical of the process by which decisions were made. This skepticism obstructed implementation of this network.

Hypothesis 16: Agreement on how *the network should operate is just as important as agreement on* what *it should provide. Without this, implementation can be problematic.*

Threat to Autonomy

The final operational dimension (the threat that the network poses to institutional autonomy) can be one of the most important in determining network effectiveness. If institutions feel highly threatened by the network—for whatever reasons and regardless of whether these perceptions are accurate—the computer consortium will probably be ineffective.

Obviously, only history can measure the actual level of threat that the consortia pose. Yet impressions from interviews do reflect the relative level of threat to institutional autonomy posed by each consortium. In New Jersey implementation was characterized by a high level of concern for institutional autonomy. During the planning of the state's second network, the Rutgers faculty threatened censure of the institution's president for planning a state-owned, campus-based resource without consulting them. With the establishment of the state's third network (NJECN), planners took strides to eliminate any threat to institutional autonomy by giving the representative from the state Department of Higher Education a non-voting position.

From its inception, MECC was envisioned as a computing consortium that would be governed by its users. Its organizational and governance structure is built upon a broad base of user input. Moreover, the concept of cooperative computing in Minnesota has grown

gradually over the past decade since many sharing activities and overview reports preceded the establishment of MECC. All of this has resulted in a relatively smooth and rather non-threatening transition to MECC, particularly when compared to the experiences of some other states. Yet, to the systems and institutions, the MECC organization does provide a certain threat. For example, some members feel threatened by the expertise of the University of Minnesota. In turn the University and the state colleges feel threatened by the political power on which the school systems can draw because of their wide geographical base. Hence most members are maintaining a cautious posture with respect to MECC. Although many respondents questioned MECC's ability to deliver effective services to such a diverse group of users, members did not seem to be overly threatened. However, all have come to accept, sometimes reluctantly, the concept of cooperative computing as one alternative for the future.

In Illinois, the issue of institutional autonomy was not cited by respondents with the frequency or concern that it was in the other two states. It was a concern, but it simply was not as important to people in Illinois as it was in New Jersey and Minnesota.

In summary, the threat to autonomy became an issue in implementing the computing consortium only when it was already an issue in the state. In Illinois with its multiplicity of coordinating and governing boards, the review of institutional budgets by a state based agency has come to be accepted. In Minnesota, institutions have been autonomous and institutional autonomy has not been a serious issue. In New Jersey, Rutgers' autonomy with respect to the Department of Higher Education had been an issue, and it surfaced in implementing the networks.

A SUMMARY OF CONCLUSIONS

This chapter has compared in detail the differences across the three states with regard to selected components of the structural model. From this discussion we can also draw some general observations.

First, all of the consortia are dominated by the state's major university. Major universities possess the computing expertise and the staff necessary to complete the background work for debates on cooperative issues. Major universities also possess the prestige to wield the political power to ensure that their position is given a thorough hearing. Finally, major universities possess the political savvy and experience to negotiate in this setting. Taken together, these factors result in major university dominance, regardless of the type of computing configurations or sharing arrangements implemented.

Second, it is essential to provide a stable funding base for the consortia. Financial problems, as well as technological or organizational ones, can plague effective network implementation. Also, the long-range implications of funding alternatives must be watched carefully.

Third, consortium computing configurations seem to reflect membership characteristics. Configurations that are incongruent with the characteristics of the members have a meager chance for success. In each of the case study states, configurations evolved until they were consistent with membership characteristics.

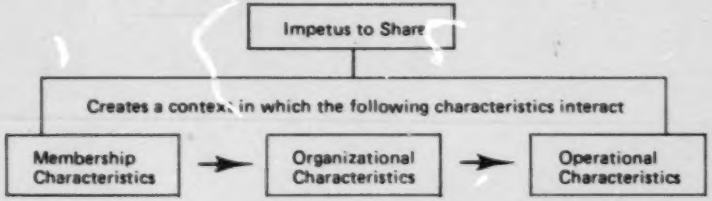
Fourth, governance of the networks reflects previous cooperative ventures and the political climate in the state with the procedural detail provided by the network plan. Although MECC has not been free from controversy, it has been governed more effectively than the other two consortia. Three factors have contributed to MECC's relatively smooth operation: a number of prior successful cooperative activities; careful delineation of governance procedures in the plan; and an attitude throughout the state government which supports cooperation. In contrast, the first two New Jersey computing consortia were the battle-ground for fighting the war on institutional autonomy. The volatile political climate and the lack of a detailed plan prevented the effective operation of the state's consortia. In the absence of governing board intervention and with a new director and significant input by Rutgers, there is optimism that the third network (NJECN) will function more effectively.

Fifth, goal unanimity does not characterize these networks. The major universities' desire to preserve the status quo coupled with their influential position runs counter to effective resource sharing. Four-year state colleges seek new computing services while the state government is looking for a mechanism which will lead to rational and systematic planning of computing. Only the future will tell if these different goal priorities can co-exist and still allow effective implementation.

Sixth, as with other examples of interinstitutional cooperation, successful cooperative computing has enlarged the scope of computing without cutting into any participant's domain. However, cooperative computing has not reduced real expenditures nor are there many cases of its being able to reallocate resources (i.e., taking from one institution and giving to another).

As a final summary of these findings, the fifteen hypotheses that were proposed are related to the structural model in Figure 6.5.

FIGURE 6.5
An Overview of Operational Hypotheses



I. IMPETUS TO SHARE

Hypothesis 1: Forceful interventions on behalf of cooperative computing generally are required for the establishment of an implement organization.

Hypothesis 2: If a new computing organization is to be established, individuals must be involved in the planning process who have the authority and the experience to make institutional policy decisions and who have interests beyond the domain of the individual participating institutions.

Hypothesis 3: Directed sharing will usually lead to the establishment of an implementing organization, but it does not guarantee active or total participation by the members in the network.

II. MEMBERSHIP CHARACTERISTICS

Hypothesis 4: There is no unique combination of membership characteristics required for successful implementation.

Hypothesis 5: Membership characteristics that work against cooperation must be overcome if implementation is to occur.

Hypothesis 6: Implementation should build on the computing environment of member institutions rather than run counter to it. Existing expertise and available hardware of network members should be utilized within the consortium configuration whenever feasible.

Hypothesis 7: For effective implementation to occur, a cooperative attitude toward computer sharing must exist. Previous cooperative ventures, particularly those which are regarded as effective, can build the requisite cooperative attitude.

III. ORGANIZATIONAL CHARACTERISTICS

Hypothesis 8: The coordinating/governing board, although playing an active role in planning, will assume a much less active role in the implementation of the network.

Hypothesis 9: Regardless of their level of involvement in sharing activities, major universities exert the most influence on consortium policy decisions.

Hypothesis 10: The relative level of influence of the coordinating/governing board on policy decisions is a vestige of the role which it played in planning the network; also contributing to the board's influence is the authority (i.e., potential) it possesses for intervening in network affairs.

Hypothesis 11: The development of a consortium needs special, one-time funding arrangements to guarantee initial operation. Continued network operation demands a stable financial base from which detailed financial projections can be made.

Hypothesis 12: Although no single hardware configuration is best for educational networks, network stability in the form of effective services rendered to a maximum number of members will not be attained until the hardware configuration adequately matches membership characteristics.

IV. OPERATIONAL CHARACTERISTICS

Hypothesis 13: Statewide computing consortia establish a common awareness across institutional members of each others' strengths, weaknesses, and challenges. The newly established relationships are frequently one of the major initial accomplishments of computing consortia.

Hypothesis 14: Institutional members of consortia will rank goals on network *governance* as being more important than goals on institutional autonomy, new computing services, or coordination/planning. In contrast, network staff will view the *coordination and planning* for the systematic expansion of computing as being the most important set of goals for the network.

Hypothesis 15: The likelihood of a policy being enacted will be determined by the payoff to the more influential constituencies within the consortium. The proposal that is ultimately chosen must have at least a non-negative payoff to the most influential constituency.

Hypothesis 16: Agreement on *how* the network should operate is just as important as agreement on *what* it should provide. Without this, implementation can be problematic.

CHAPTER 7

Applying the Findings on Statewide Computing Networks

This chapter takes the reader beyond the specific findings of this research on statewide computing networks in order to fulfill three goals. On one level, the intention is to encourage the use of tools which may be useful in future efforts at establishing and/or assessing new networking ventures. To this end, the process and structural models are evaluated on the basis of their general usefulness as analytical and comparative instruments. A second aim is to identify specific findings that provide a basis of knowledge for developing future cooperative arrangements. Findings are chosen that illustrate the relative workability of cooperative networks and the manner in which state government leaders, computing center managers, and institutional leaders can influence the outcomes of the cooperative process. The third goal of this chapter is to assess potential directions in which interinstitutional networking may be heading and to determine whether statewide networks will encourage the ultimate achievement of these outcomes.

UTILIZING THE PROCESS AND STRUCTURAL MODELS

Two distinct yet interrelated models of cooperative computing are utilized by this research. The *process* model describes the stage-by-stage flow of events which characterizes the planning and implementation of cooperative computing ventures. The *structural* model is somewhat different in character; it focuses on one stage of the cooperative process, implementation, and proposes a taxonomy for contrasting and evaluating the structural aspects of cooperative computing organizations.

To many practitioners, the formulation of such models may seem to be an overly academic exercise. Their relevance to the day-to-day activities of planning and implementing computer networks may be subject to question. In addition, many observers of the computing scene view the ebb and flow of events in their state as being unique. For these reasons, theoretical models may be considered to have little practical value.

The authors challenge these objections. First, these models undoubtedly will not provide the practitioner with a "how-to-do-it" guide for all planning and implementation decisions. Yet these models focus on the important factors which influence cooperative computing, and enable the policy maker more clearly to distinguish between the effects of different factors. Second, this research has identified consistent patterns of events that characterize statewide computing organizations in different states. Thus the practitioner is able to learn from the common experiences of other institutions in different states.

At the beginning of this research project, the models were created as tentative frameworks awaiting empirical verification. The data and analysis both supported the utility of these models and suggested refinements that have been incorporated in the final versions of the models that appear in this report. While the process and structural models have served admirably as generalized research frameworks, they have other potential uses as well.

Both of these models may be used as *analytical* and as *comparative* tools. Computer center directors, institutional presidents, commissioners of higher education, staffs of state legislative agencies, and other parties may find these models useful as they confront decisions on cooperative computing. As analytical tools, both models offer computing decision makers a framework within which to evaluate the current state of computing affairs. For example, a state agency could evaluate a recent planning process by using the process model to segment the recent activities into manageable portions. The staff of a coordinating board could also analyze a proposed implementing organization using the structural model as a guide.

Using these models as comparative instruments is a higher order of utilization. Comparative usage could involve using the structural and process models to compare two proposed planning processes organizations, or to contrast a proposed organization with existing ventures in a similar state. For instance, educators in Alabama could use the process and structural models to ascertain why cooperative computing has taken such a different form in Mississippi and to propose ways of altering their situation to foster more progress. Moreover, the findings from the national survey and case studies can be used as a detailed bank of

comparative information. A variety of parties could draw on this information to assess existing organizations and processes, plan for new initiatives, or predict the success of proposed ventures. These two models (and the data presented here) provide a basis for a variety of analytical and comparative activities in support of judicious computer networking.

UTILIZING THE FINDINGS OF THIS RESEARCH

The demonstrated utility of the process and structural models is enhanced substantially by the many findings of this research. Not only do these findings provide a rich data base of comparative information, but they help potential participants in the cooperative process to identify how best to invest their efforts at each stage. The following discussion demonstrates how the roles and activities of these different constituencies may be structured, using the findings of this research. It also summarizes what the findings suggest about the workability of existing networking ventures.

Implications for Different Constituencies

The results of the national survey and case studies predict, in light of the evolution of cooperative computing, the future relative roles of at least five constituencies: state government personnel (e.g., legislator, governor, the staff of state agencies), the coordinating/governing board and its staff, the institutional leader (e.g., president, vice president), the director of the institutional computing center, and the institutional user of computing.

State Government. There is little doubt that the heaviest involvement of state government officials occurs during the beginning stages of cooperation. This group most often acts as assessor of a performance gap. Legislation or an executive order often serves as an indirect intervention that leads to the establishment of a committee to plan for cooperative computing. After these initial stages, the role of state government personnel diminishes. Their involvement increases when a statewide plan is submitted for approval, and special funding is requested to establish a computing cooperative. Again their participation subsides until refunding or a review of effectiveness is required.

There are a number of crucial issues that state government officials must consider with respect to cooperative computing. First many state officials believe firmly that cooperation, in and of itself, is a good thing. Hence, they aggressively demand formulation of a statewide plan and require that cooperative ventures must be considered. Yet, these officials do not have a clear vision of what the cooperative will look

like, nor do they have any sense of how its effectiveness can be assessed. As networking matures, its effectiveness will be questioned and measures must be developed. Second, state government officials must ask themselves if they wish to continue to treat postsecondary computing as a special item to receive special oversight and scrutiny. Third, they must decide whether postsecondary computing should remain separated from elementary/secondary computing, or whether even broader cooperation is possible.

From this overview, two broad generalizations may be drawn: 1) State government officials should be aware of their changing roles at different stages in the cooperative process; 2) An important agenda of questions must be resolved by state government officials as the future of cooperative computing unfolds.

Coordinating/Governing Boards. Similar to the "state government" constituency, the involvement of the coordinating/governing board is heaviest during the initial stage of cooperation. In contrast, however, these boards or their staffs remain actively involved throughout the planning process and the approval of the statewide plan. During the planning process, coordinating boards are frequently negotiated out of a major role in the operation of the computing cooperative. In this way, institutions move to control their own destinies. The establishment of an independent computing cooperative, whose day-to-day activities fall beyond the purview of the state coordinating agency, is perceived as an attractive instrument to achieve this purpose. Coordinating/governing boards are generally willing to pass this responsibility on to some other organization, correctly perceiving their role as primarily one of review and not of providing services directly to institutions.

Coordinating/governing boards and their staffs must define their place in the future of cooperative computing. As with state government officials, the assessment of effectiveness must be a major concern. Coordinating boards and their staffs must also be aware of the supportive role that they can play. For example, a special grant to cover developmental costs of establishing a cooperative center can be a potent incentive to motivate institutions to enter a cooperative agreement. It can also help to alleviate the initial cash flow problems that confront such organizations.

These boards must also be cognizant of the new, three-party relationships which will result from the establishment of cooperative computing centers. The coordinating board and its staff will have to interact with both the institutions and the cooperative organization. At times, the board will be called upon to serve as an intermediary in resolving differences between the other two. On other occasions, the

board will have to deal with a carefully articulated cooperative position on computing.

The biggest challenge facing coordinating/governing boards (and state government, as well) is to use wisely their considerable leverage and to remain flexible concerning the creation/dissolution of cooperative ventures. The active involvement of parties external to the institutions have been shown conclusively to be a powerful stimulant to the creation of more ambitious and all-inclusive networks than would have resulted had the institutions been left to their own devices. On the other hand, too much directiveness or pressure for particular types of sharing that may not be in the best interests of the institutions have often created dysfunctional outcomes. External agents must cultivate the knowledge necessary to allow the development of systems congruent with each state's needs.

Institutional Leadership. Cooperative computing requires the active involvement of academic and administrative leadership in the planning of cooperative computing and in the setting of policy for the statewide consortium, should one be formed. Because planning decisions will significantly affect the institution's relations with other institutions (and external agencies) institutional administrators must actively determine cooperative computing policy. The leadership exerted by these individuals is one of the very most powerful determinants of the success or failure of cooperation.

Institutional leaders must address squarely the question of what goals their campus holds for computing. Are they content with purchasing services from a centralized state center, or does the institution feel that it is an important goal to foster its own, on-campus computing capabilities? What sorts of services are really needed? How much money should be expended? The answers to such questions will determine the institutional president's posture with respect to planning and implementation. Finally, institutional leaders must recognize that they will be relinquishing some of their autonomy if a cooperative center is established. The resulting patterns of interactions and decision making will be far different than those which have characterized institutional computing in the past.

Computer Center Directors. The computer center director feels most directly the impact of cooperative computing. Never again will computing at the institutional level be considered completely independently; rather, it will be seen as existing within the statewide constellation of computing needs and resources. The campus director will need to interact more with directors at other institutions, including institutions that have different levels of expertise, sophistication, and needs. The campus director will also need to develop a close working relation-

ship with the president of his campus, in order to construct and coordinate policies to be taken to the cooperative board.

The service responsibilities of the computing center director may also be altered radically. Instead of serving campus users primarily, the computing center director may be acting in the role of "middleman." While the director will continue to facilitate use, as in the past, he/she will no longer have direct control over service. Campus directors will also need to be cognizant of the potentials and capabilities of other computing centers and external resources. Different personal styles may be required for successful operation in this milieu. Even greater sensitivity to user needs will be essential. The campus director should be aware increasingly that "recreating the wheel" is unnecessary each time a new application is requested. In short, the role of campus computer center director is being changed by the same forces, and in the same manner, as that of many other campus leaders who must deal more and more with parties external to their institutions.

Users of Computing. In many cases, the users of computing have objected most violently to the establishment of a statewide computing center. Users have assumed that this center would not provide adequately the types of services to which they had become accustomed. In some cases they have been proven correct. In others, the range and quality of services may have actually increased. In any case, there is little doubt that cooperative computing may remove the user from the primary seat of computing power. This "distance" can be translated into less responsive service and/or a feeling that the user is not being involved in computing decisions. For these reasons, the involvement of the user perspective in the planning process is of paramount importance. This involvement should begin during planning and reach a crescendo during implementation.

If cooperative computing flourishes, many different forms of networking may be available. For example, single institutions may have access to the ARPANET, the PLATO system, the National Center for Atmospheric Research (NCAR), and perhaps their own statewide/regional network—not to mention the myriad of commercial service bureaus willing to sell their resources. The campus user may have to become a well-versed computing consumer, shopping around for the best services at the best price.

Limits to Cooperative Computing

Although a definitive assessment of the performance of networking has yet to be performed, our research has shed some light on the *limits* to cooperative computing. While most networking ventures have been

relatively successful in expanding the total computing resources available and in serving computing have-not institutions, networking has proven unable actually to redistribute existing resources. Networking has enabled *cost avoidance,* the avoidance of costs that would have been incurred if cooperation had not been undertaken. On the other hand, it has generally been impossible to achieve *cost savings,* a true decrease in expenditures. This is congruent with findings for other types of interinstitutional consortium activities.

This research has identified a host of process factors that can facilitate the establishment of ambitious networking arrangements. However, the relative ambition and comprehensiveness of networks are inappropriate as measures of effectiveness. The case studies provide examples of plans that were overambitious, or incongruent with the characteristics of the participants, and that resulted in prolonged implementation. It is attractive to suggest that the most effective planning process should contain the proper combination of *directiveness, participation, technical expertise,* and *administrative acumen.* Directiveness is provided by interventions and mandates of external parties and by an implementing organization with appropriate powers and a willingness to use them. Participation is provided by the involvement of representatives from a variety of institutions, the coordinating/governing board, state government, or consulting agencies. Technical expertise, including a comprehension of the possibilities and real limitations of cooperative computing and a sensitivity to the legitimate differences between differing types of institutions, is often provided by institutional participants. Administrative acumen, an understanding of the sorts of compromises and political decisions necessary to achieve a successful cooperative effort, and the ability and willingness to look beyond current conditions to consider long-range impacts of alternative systems must be provided by all planners. While the particular formula varies from state to state, some combination of these elements is essential.

The ultimate computing configuration and implementing organization must also be congruent with the conditions and needs in the particular state in question. Many states must go through several iterations of the entire planning cycle, or a series of evolutionary implementation activities before a congruent networking scheme results. The speed with which a workable networking arrangement is achieved depends on the skill with which these conditions are read.

Although the process and structural models take a first step in analyzing the appropriateness of networking schemes, further assessments of effectiveness are needed. These assessments must move beyond measures of appropriateness and consequences to include evaluation of the effectiveness of user services provided by networking

ventures. Until such a framework is constructed, the success of cooperative computing will continue to be assessed imperfectly by an assortment of parties having differing goals that may be at odds.

THE FUTURE DEVELOPMENT OF COOPERATIVE COMPUTING

There can be no question that statewide computing networks have contributed materially to the continued development of cooperative computing. These systems are breaking down the barriers to interinstitutional cooperation; never again will public educational institutions be allowed to address their computing needs without consideration of the cooperative alternative. Moreover, statewide networks are providing the structure and precedent for the continuing involvement of external agents in fostering cooperation. In the current educational climate of selective growth and retrenchment, this involvement may be expected to continue or even increase.

However, statewide networks must be viewed in proper perspective. In addition to statewide computing networks, the computing user may access a variety of international, disciplinary, regional, and special purpose networks. The networking environment of the future will surely depend on the proper availability and combination of these different networking arrangements. It is still unclear whether the particular characteristics of statewide networks (the characteristics that enabled them to overcome barriers to interinstitutional cooperation) will provide the flexibility to allow the evolution of the best computing arrangements for the future.

Developing the Cooperative Computing Climate of the Future

Current networking arrangements are in a state of flux. The development of advanced minicomputers has challenged the reliance on large central computers. Most computing users can have the great majority of their tasks accomplished by the capabilities provided by the mini's. This is especially true for regional state colleges and universities, the major group of institutions serviced by statewide networks. An interesting adaptation is the development of hierarchical networks in which a large central computer is linked to intelligent terminals (terminals containing a minicomputer) that perform relatively simple tasks and route more complicated jobs to the central facility.

A further complication is presented by the notion of a free market for computing services. In most statewide networks, the institution is

the bargaining party. However, in the future, schools or colleges within the institution, disciplines within colleges, and even individuals with specialized needs may negotiate independently.

Many statewide networks have identified the difficulties resulting from grouping together users having different needs and levels of sophistication. For example, researchers within a particular discipline, or users at Harvard and MIT have much more in common than do users at a state college and the state's major public university. Also, many feel that centralized computing utilities, such as those established by some states, may tend to slow the rate of innovation in computing, may be less responsive to users' needs, and may even experience diseconomies of planning, management, and control.[33]

Some observers of the computing scene feel that these shortcomings will be overcome through the evolution of a national networking capability. The National Science Foundation has discussed the notion of a national science network. EDUCOM, the Interuniversity Communications Council, has established a Planning Council on Computing in Education and Research that is establishing a facilitating network to link the major computing facilities of twenty-one of the major research universities in the United States. It seems plausible that an evolving national network could consist of the following: a national, distributed network linking the major research universities in the United States (and perhaps foreign universities), remnants of certain statewide and regional systems, disciplinary networks for users with highly defined needs, and considerable stand-alone computing in the form of minicomputers and specialized laboratory equipment. In all probability, there would be considerable cross linking of the national, statewide, and local facilities using telephone lines, satellite communications, and microwave links. Facilitating organizations would be established for the purpose of joining users having certain needs with the facilities best suited to their computing tasks.

This potential network would be "distributed" in the sense that services would be provided by a number of major universities, regional and statewide networks, and laboratories that would be mutually linked, rather than by a single, central facility. It would be "hierarchical" in the sense that less sophisticated users would perform most tasks on local equipment, only accessing the higher level capabilities for specialized jobs. It would include some facilities providing highly specialized services and others furnishing "general purpose" computing. Perhaps the most unique feature of this evolving network environment

[33] William F. Massy, "Computer Networks: Making the Decision to Join One," *Science*, 186 (December 20, 1974):414-19.

is that it could function as a "free-market" structure where individual users could contract for services on whichever of a variety of specialized or general-purpose facilities suited their needs at the most reasonable cost.

Operating computing in a market system is a task that is unfamiliar to most educators. It is likely that the large computing center of the future will be a specialized shop, performing one or two sorts of sophisticated computing chores exceedingly well for users from all over the nation—or even the world. General-purpose computing of limited scope may be performed by local minicomputers, older local computers that are technologically obsolete but still serviceable, and by regional or statewide centers that achieve economies of scale for certain groups of institutions. The choice of which facility to use would be left to the individual user, subject to the limitations of resources and of strategic and tactical decisions made by the institution.

Potential Liabilities of Statewide Networks

As was discussed earlier, the true effectiveness of statewide computing networks is not yet clear. Further, many observers believe these networks will hinder the ultimate evolution of a distributed, hierarchical network system of national scope. The source of this assessment is the belief that statewide networks as presently operated are inimical to the flexible, freewheeling, individualized mode of operation that appears necessary for the operation of a free market networking environment.

These beliefs are supported by a number of findings from the research. Performance gap assessors appear to be unable to assess network effectiveness and relate it to their goals, of expanded service, cost-efficient operation, and the like. In the absence of demonstrable outcomes, they accept cooperation as virtuous and the existence of a centralized system as proof positive that computing needs are being met. Suppose future developments suggest that the major university withdraw from participation or that the network disband? Whether these external parties would be willing to accept such an outcome is questionable.

The creation of a new computing organization establishes another level of hierarchy with a vested interest in the maintenance of the new status quo. Given the rarity of a state agency being disbanded, the creation of a networking organization may be tantamount to creating a permanent new actor on the computing scene.

Another potential shortcoming of statewide networks is the apparent need of external state agencies to maintain some level of "control" over operations. In a flexible, free-market networking

environment, computing resources and money flow freely among parties, often crossing state and other jurisdictional boundaries. Some observers of the computing scene have predicted that under such circumstances, it will only be a matter of time before some attorney general will question the propriety of such arrangements or some legislature will object to such a loss of "control."

In addition, many observers question whether the minicomputer revolution has not obviated the need for networks accessing large, general purpose computers. If this is the case, existing statewide networking arrangements may prove ultimately to be obsolete and costly.

In short, a major challenge facing statewide computing cooperation is the maintenance of the degree of flexibility necessary so that these networks can die, if the situation so warrants, as handily as they were brought to life. At the heart of this flexibility is the ability to assess the true effectiveness of these ventures and other networking approaches, so that networking can be evaluated by institutions and the external parties that regulate them on the basis of the substance of cooperation, and not the form, alone.

Summary of Participants in National Survey

State	Participants: Institution	Participants: State Government	State	Participants: Institution	Participants: State Government
Alabama	0	1	Montana	2	1
Alaska	1	0	Nebraska	1	1
Arizona	1	1	Nevada	1	0
Arkansas	1	1	New Hampshire	1	1
California	1	1	New Jersey	1	1
Colorado	1	1	New Mexico	1	1
Connecticut	0	1	New York	3	0
Delaware	2	0	North Carolina	1	1
Florida	0	1	North Dakota	1	1
Georgia	1	1	Ohio	1	0
Hawaii	1	0	Oklahoma	1	1
Idaho	0	1	Oregon	1	1
Illinois	1	2	Pennsylvania	1	2
Indiana	1	1	Rhode Island	1	1
Iowa	1	1	South Carolina	1	1
Kansas	1	1	South Dakota	0	2
Kentucky	1	1	Tennessee	0	2
Louisiana	1	1	Texas	1	2
Maine	1	0	Utah	0	1
Maryland	1	2	Vermont	1	0
Massachusetts	1	1	Virginia	0	2
Michigan	0	1	Washington	2	1
*Minnesota	4	4	West Virginia	1	1
Mississippi	0	1	Wisconsin	2	2
Missouri	0	1	Wyoming	1	2
			Totals:	48	54

*Minnesota was selected as a state for a pilot test of the national survey. This state was visited to discuss the project with a representative set of participants. This is the reason for the large number of respondents.

Characteristics of Persons Interviewed in Case Studies

	Minnesota	New Jersey	Illinois	Totals
Institutions or Organizations Represented:				
Legislative or State Government Staff	3	1	2	6
Coordinating Board or Boards of Regents Staff	2	4	4	10
Consortium Staff	3	5	1	9
Regional Consortia	1	0	2	3
Institutional Representatives:				
Major Public University	4	4	3	11
State Colleges/Universities	4	2	9	15
Community Colleges	2	1	1	4
Private Colleges	2	1	0	3
Secondary Schools	6	0	0	6
Types of Interviews Administered:				
Planning-Implementation Interview	9	10	6	25
State Government Interview	2	1	2	5
Institutional User	16	7	14	37
Totals	27	18	22	67

APPENDIX B

Case Histories of Three Statewide Consortia: Minnesota (MECC), New Jersey (NJECN), and Illinois (IEC)

This appendix explores in some detail the planning and the formation of the statewide computing consortia in Minnesota, New Jersey, and Illinois. These three states were selected for in-depth analysis for three reasons: 1) each state was similar in that it had established an autonomous educational computing organization; 2) each state had faced different planning and implementation issues; and 3) because each had undertaken ambitious plans for computer sharing, it was our assumption that their experiences would be most instructive.

These case studies are descriptive and trace the factual details of the planning and implementation of these three consortia. To the reader from one of these three states, this description may seem overly general.[34] To the reader from outside the state, each case study may seem too detailed. Yet these case studies lay the foundation for the analysis and the sixteen operational hypotheses which were presented in Chapter 6. These hypotheses represent the heart of our findings on implementation.

The case study for each state is organized similarly. First, the important activities which led up to creation of the consortium are presented. Then the formation of the consortium is discussed, followed by a review of the consortium's activities. Each case history is summarized by a brief discussion of the strengths and weaknesses of the consortium as reported by the interviewees. A timeline of major activities also accompanies each case study.

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[34] Readers who want more detail and analysis of each state's experiences are referred to the original research document: Richard B. Heydinger, "An Exploratory Study of the Operation of Technological Consortia: The Experiences of Three Computer Networks" (Ph.D. dissertation, The University of Michigan, 1976), pp. 133-281.

Minnesota: The Establishment of an All-Inclusive Computing Consortia

Unlike most other states, Minnesota has formed a single, statewide educational computing consortium which services *all* systems of education from "kindergarten through grade 20." Not only is this effort an ambitious one, but today the Minnesota Educational Computing Consortium (MECC) is a viable computer cooperative. While many states have envisioned the establishment of a MECC-like consortium, few, if any, have been able to equal Minnesota's progress. A careful examination of Minnesota's history of educational computing demonstrates the evolution of this state's cooperative spirit.

SHARING ACTIVITIES PRIOR TO MECC

In the late 1960's a series of events preceded the establishment of MECC which were important stepping stones in the evolution of the state's computing consortium. First, twenty-eight secondary school districts in the Twin Cities area formed a data processing cooperative named Total Information Education Services (TIES). This was one of the nation's first centralized computing consortia involving such participants. In southern Minnesota another cooperative was established which provided access for rural public schools through the Mankato State College computing facilities. Although such arrangements are commonplace today, these successful projects demonstrated that cooperation could provide effective computing services, a discovery which was recognized by both the legislative and executive branches of the state government.

In the late 1960's, as in many other states, the governor imposed a freeze on all computing expenditures. Simultaneously he appointed a blue ribbon committee charged with producing a plan for all state government computing. Because higher education was viewed as a unique governmental sector, this plan contained a separate chapter on the future of computing in Minnesota's colleges and universities. Over time this chapter assumed an identity of its own with several of its provisions having major impact. First, it "officially" called for cooperative computing amongst the state colleges and universities; and secondly, the financial projections in this report provided a benchmark against which future requests for funding could be compared. Henceforth, resource sharing was viewed as a viable alternative and institutions began to see themselves as part of a constellation of educational

computing, not isolated resource centers. Clearly, this report represented a turning point for cooperative computing in Minnesota.

A second turning point was marked by the legislature's intervention into educational computing. In 1971 the legislature gave the Commissioner of Administration the power to review and approve all computing expenditures. Institutions were no longer able independently to make their own decisions with respect to computer purchases. Rather than directly utilize this authority, however, the Commissioner appointed an ad-hoc committee on computers in education and charged this group with investigating possible ways of coordinating computing at all levels of education. In effect this action returned authority to the educational community, but it left little doubt as to where the ultimate power resided.

During this same period, Minnesota established its first higher education cooperative computing system, the *M*innesota *E*ducational *R*egional *I*nteractive *T*ime *S*haring *S*ystem (MERITSS). Through the coordination efforts of the Higher Education Coordinating Commission (a board with advisory powers) and the willingness of the Control Data Corporation to provide a CDC 6600 computer at below cost, this regional timesharing utility was formed. MERITSS provided timesharing services to the University of Minnesota, the state's community and state colleges, and a number of private institutions. This venture strengthened the cooperative attitude which was being established in Minnesota.

Taken together, this series of cooperative activities combined to create a substantial momentum toward statewide planning. As of May, 1972, three successful, cooperative hardware links had been established. Two of these not only linked independent institutions but crossed autonomous systems of education. During this same period, the state government had taken an active role through executive orders and legislation. All non-educational state government computing had been centralized, and this was proving to be an effective and economical alternative to the problems of computer proliferation. With this as an example, state government officials were now convinced that cooperative computing was a viable alternative for public education. Finally, a number of significant study and planning documents had been produced. These documents encouraged institutions to see themselves as potential participants in cooperative ventures. Moreover, these reports contained detailed financial data and usage information which could be used as input data for a comprehensive statewide planning process. It was all these events acting in concert that created a climate conducive to cooperation. A statewide planning activity was a logical culmination of these events.

THE PLANNING AND FORMATION OF MECC

In July 1972, the Governor's Joint Committee on Computers in Education was appointed and directed to submit a statewide computer plan by September 1972. The charge given the Joint Committee left no doubt that cooperative computing was assumed to be both feasible and desirable. The statewide plan was to include:

> . . . *all* levels of education, *all* students in Minnesota education, all educational functions and *all* services desired by the educational systems, institutions and agencies which will be users of this service.
>
> ["Minnesota Educational Data Processing to 1980," October 1974 MECC document—emphasis theirs, p. 13]

This committee included representatives from all relevant constituencies. It was apparent from personal interviews that this planning group was regarded as a highly qualified set of individuals. Members of the committee lauded the planning process as extremely fair with each constituency being given an opportunity to express its views. Moreover, the short time frame prompted the group to work efficiently and move toward completion of a plan.

In September an initial draft of the computer plan was circulated for critique. After some modifications, on February 15, 1973 Minnesota's first statewide educational computer plan was published. Shortly thereafter influential parties in the executive branch of the state government voiced their support of the plan, and the state legislature followed with its support for the creation of MECC. With all the parties officially supporting the concept of a statewide computing consortium, a joint powers agreement[35] amongst the state's five educational systems was signed in April, 1973. MECC was to be a reality.

As the plan specified, MECC would have a sixteen member board—six representatives from the elementary-secondary-vocational sector, six from the higher education sector, three appointed by the governor, and one representative from the Department of Administration. Member systems[36] would also appoint sixteen representatives to the

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[35] The Joint Powers Act permits any state agency to assign a subset of its own statutory authority to a second organization. This legislation has permitted a number of consortium agreements and was instrumental in the formation of MECC.

[36] The five member systems include the University of Minnesota, the State University System, Community Colleges, the Department of Education, and the Department of Administration.

MECC Advisory Council, a group established specifically to advise the executive director of the consortium on technical and policy matters. These appointments were completed in June. The legislature officially endorsed the concept of MECC by funding liberally the computer requests of each system. And on July 1, 1973, MECC officially came into being.

MECC'S FIRST THREE YEARS: 1973-1976

The MECC plan was an interesting combination of detailed plans and open-ended objectives which provided the structure for operationalizing this statewide consortium without constraining its flexibility. The organizational structure of MECC and governance procedures were spelled out in detail; also included was a procedure to handle grievances. Yet, the plan did not contain specifications for the types of computing services MECC would provide or who would own and operate such facilities. Instead, the plan specified broad goals of cooperation and outlined service alternatives. The plan did develop a set of suggested priorities for implementation during the first biennium, the 1973-75 period. These called for an emphasis on the establishment of a statewide instructional time-sharing system which would not only be highly visible but could most easily offer services to "have-not" students. In retrospect, this plan seems to have provided an appropriate mix of structure and flexibility for the transition to a comprehensive educational consortium. Undoubtedly the careful attention to organizational structure and governance procedures smoothed this transition.

MECC began its first year with a flourish of activity. An acting director was appointed; the selection process for a statewide instructional time-sharing system was begun; a permanent site for MECC headquarters was selected; and the search for a permanent executive director was begun.

This series of initial activities was important, for it demonstrated that MECC was indeed alive and functioning as an organization. To the skeptics, this vigorous course of action indicated that the parties involved were serious in their attempts to establish a consortium.

During MECC's first year of operation, the consortium offered 29 workshops throughout the state to familiarize faculty at all levels of education with MECC and the potential for instructional use of computers. A permanent executive director was hired, and the staff generated publicity in response to the many inquiries regarding MECC and its operation.

Without a doubt the most controversial activity in this first year was the selection of a time-sharing system. It was planned that this com-

puter system would become the state's major instructional time-sharing system, serving users from the primary school level through graduate school. The details of this selection procedure are recounted here to demonstrate how this controversial decision was handled by this particular consortium.

Upon determination of the selection criteria by a special task force, the bidding process was opened in the spring of 1974. Most initial bids were eliminated because they did not meet the bid specifications. Control Data and UNIVAC remained in competition and performance tests were agreed upon. The machines were benchmark tested, and it was decided that both systems had met the bid specifications. After a confusing evaluation of the factors involved in each bid, the contract was awarded to UNIVAC. Immediately CDC and its proponents charged officially that conversion costs had been ignored and the selection had been made improperly. Charges were also levied that the benchmark criteria had been manipulated. Finally, the MECC Board agreed that a new performance test would be scheduled and that this one would be witnessed and evaluated by an outside consultant. This test was conducted in November, 1974, employing a process approved by the consultant. Finally, on December 18, 1974 the MECC Board unanimously approved the selection of a UNIVAC 1110 as the statewide time-sharing system. Yet the controversy was not quite over. The following spring the legislature became embroiled tangentially in the controversy by calling MECC officials before a legislative hearing to review this bidding process in order to determine if it should be reopened. Testimony in committee evidently convinced the legislature that there was no need to reopen the bidding, and the UNIVAC 1110 remained on order.

This hardware decision was made in the full view of the public, out of necessity. Thus the process was open to criticism by any knowledgeable computing professional. The University of Minnesota, with its CDC time-sharing system, had a great deal to lose if conversion to a UNIVAC system were forced upon it. The State University System had much to gain since its time-sharing machine was a UNIVAC 1110. Not only did the vested interests run deep, but the fact that Minnesota is the corporate home of both UNIVAC and Control Data added fuel to the raging controversy. It is a credit to MECC and the institutions of the state that at least on paper all educational systems came out in support of this selection.

During this drawn-out selection process (January, 1974—July, 1975) MECC continued with its developmental activities. Although the installation of a single statewide time-sharing system had been delayed, MECC managed to pull together five existing time-sharing systems to

provide services. Although these computers were not linked, MECC was able to use its coordinative powers to offer time-sharing on 455 ports at an equal cost for all users. This stop-gap measure demonstrated the range of resources available to this statewide consortium.

Finally in August, 1975, the statewide time-sharing network was brought into operation. Initially its services were problematic, yet by Spring, 1976, the system was servicing 320 users simultaneously. During this first year trial period the system passed its first of a two-phased acceptance test. However, before the second phase of tests was begun, the decision was made to terminate the contract on the UNIVAC 1110. "Increasing costs, significantly increasing volume and divergent educational requirements contributed to the mutual decision," as the MECC newsletter explains. An outside consultant's report cites the impossibility of finding a computer which could simultaneously serve the divergent needs of the MECC user population. UNIVAC has been commended for both their effort and expertise in implementing this system. The fact remains, however, that a single system has not been able to service the needs of this consortium.

In addition to instructional time-sharing services, the state plan also gave priority in the first biennium to the development of administrative data processing capabilities for elementary-secondary schools. Hence, after review by a select committee, in November, 1973 ADP for the public school systems was drawn into seven regions. A contract was signed with Burroughs to provide B-1700's and/or B-6700's as data processing machines for each of these regions. Currently, prototype software is being developed which can be implemented in each of the regions to provide the school districts with data processing capabilities.

Today MECC faces a number of challenges. Time-sharing services are presently unresolved. Before the biennium appropriation in the Spring of 1977, MECC must have demonstrated substantial progress in servicing both the instructional time-sharing and the administrative data processing needs of a significant number of the school districts. All this must be done while at least coordinating the development of computing services in both postsecondary and elementary-secondary education.

MECC'S STRENGTHS AND WEAKNESSES: A SUMMARY

Four major strengths of MECC have emerged. First, the demonstrated commitment by each of the systems (particularly at the executive levels) was recognized as a primary strength by persons who were interviewed. Although computer center directors at the institutions may question the MECC approach, system heads have committed themselves to testing the feasibility of a statewide consortium.

Second, respondents cited the breadth and depth of expertise available to MECC as a positive attribute of the consortium. Not only do the educational systems possess complementary expertise but the commercial sectors of the state also possess a vast array of computer knowledge. This has facilitated MECC's development.

Third, many respondents cited the potential advantages of cooperation as an advantage of MECC. For example, MECC can lead to increased access and software exchanges. In addition it has curtailed the proliferation of unnecessary hardware and provided a review and approval function which was needed. Respondents highlighted this in specific reference to the difficulty the state Department of Education was having in bringing together the many school districts across the state.

Fourth, the joint powers statute was recognized as a major strength. This specific legislation provides a vehicle for establishing such consortia and in that sense promoted cooperation.

These strengths are contrasted by four general weaknesses. First, the capability and sensitivity of the MECC staff was questioned by respondents. The lack of experience in operating large computer systems and the lack of technical expertise were cited as weaknesses. Some respondents also indicated that the MECC staff had been insensitive to the needs of members and had not involved member systems in the selection of staff.

Second, respondents were troubled by the loss of control over their own computing services portended by MECC's growth. The possible loss of autonomy and a concern for dwindling institutional input were threatening possibilities. Somewhat related to this are the jurisdictional jealousies which impact on policy formulation. Each of these concerns relates to the interface between the individual institution and the statewide consortium.

Third, MECC was seen by some as a large, cumbersome organization. All decisions require lengthy discussion and the concerns of the many different constituencies must be aired. All of this results in an organization which moves very slowly, indeed.

Fourth, some respondents wondered if MECC would become only another level of bureaucracy. While many respondents viewed MECC's review and approval functions as strengths, some respondents recognized its potential for becoming another cumbersome bureaucratic channel for the approval of educational policies.

In the eyes of many, MECC continues to make impressive progress particularly in light of the inherent problems in coordinating such a vast organization. The recent setback with instructional time-sharing may be off-set by the continued development of public school MIS. The next few years will be critical for MECC's success. The consortium must maintain the substantial momentum which was created during its planning and initial operation. These operational characteristics have left many people with a wait-and-see attitude.

THE CHRONOLOGY OF COOPERATIVE COMPUTING IN MINNESOTA

1967	Twenty-eight Secondary School Districts in the Twin Cities Metropolitan Area linked through a computer time-sharing system named Total Information Education Services (TIES).
1968	Southern Minnesota Secondary School Computing Project (SMSSCP) provided computer access to secondary schools in southern part of the state through the Mankato State College Computer Center.
1969	Governor imposed a freeze on all computing budgets (Executive Order No. 51).
	Governor's Advisory Committee on State Information Systems formed to review *all* state government computing.
1970	Governor's Advisory Committee submitted a report entitled *Information Systems in the State of Minnesota 1970-1980.* One section of this report entitled *Computers and Information Systems in Higher Education* dealt exclusively with higher education computing. It became known as the "Roll-Patton" report, named after its authors.
1971	State Legislature passed Bill 918 requiring the Commissioner of Administration to review all hardware acquisitions.
Nov., 1971	Commissioner of Administration established the Ad-Hoc Committee on Computers in Education to investigate ways of coordinating computing at all levels of education.
	Minnesota Educational Regional Interactive Time Sharing System (MERITSS) established to provide time-sharing to postsecondary institutions. This system was jointly controlled by individual systems of higher education and under the operating management of University of Minnesota.
July, 1972	Nine-member Governor's Joint Committee on Computers in Education appointed.

(continued)

The Chronology of Cooperative Computing in Minnesota (cont'd)

Feb., 1973	Final statewide plan presented to the Governor's Joint Committee, *A Proposed Educational Computing Services Organization: Its Facilities and Services.*
April, 1973	The joint powers agreement for MECC signed.
June, 1973	MECC Board of Directors, and MECC Advisory Council selected by educational systems.
July, 1973	MECC officially created with five member systems: University of Minnesota, State University College System, Community College System, Department of Education, and Department of Administration.
August, 1973	Acting Executive Director of MECC selected.
Dec., 1973	Technical Task Force for State Time-Sharing Specifications submitted its criteria for performance tests of time-sharing machine.
Academic year, 1973-74	MECC provided time-sharing services via five existing systems across the state.
Jan., 1974	First MECC Executive Director appointed.
Dec., 1974	Benchmark committee recommended purchase of UNIVAC 1110; MECC Board unanimously approved the motion.
Spring, 1975	MECC Instructional Time-Sharing Association formed.
August, 1975	UNIVAC 1110 time-sharing system installed and began offering a basic set of services.
Jan., 1976	Second MECC Executive Director appointed.
Oct., 1976	MECC terminated contract for UNIVAC 1110 time-sharing system.

New Jersey — A Three Step Evolution Toward Cooperative Computing

New Jersey has experienced three distinct phases of cooperative computing, each of which has been marked by the establishment of a new statewide computer utility. The first utility, the Educational Computer Center (ECC), was established in 1969, making it the nation's first truly statewide educational computer network. This was replaced in 1972 by Educational Information Systems, Inc. (EIS). In 1975 EIS was renamed the New Jersey Educational Computer Network (NJECN), thus inaugurating New Jersey's third phase of cooperative computing. This brief case history traces the development of each of these phases. What is most instructive about the New Jersey experience is the contrast between the planning and implementation activities of the three networks. Each network was initiated with a different impetus to share, and each was begun after a quite different planning activity.

THE FIRST STATEWIDE COMPUTING CONSORTIUM

The first formal suggestion of cooperative computing occurred in 1968 when the Board of Higher Education charged the Chancellor with investigating the feasibility of establishing a computer network. Responding to this charge, the Chancellor appointed the Computer Network Study Committee. As a result of this committee's deliberations, in August, 1969, a "Memorandum of Agreement" was created which incorporated a computer network, the New Jersey Educational Computer Cooperative (ECC), Inc. This network was to utilize the Rutgers IBM 360/67 and provide leadership in both academic computing and administrative data processing for the "interested colleges and universities."[37] Subsequent to this initial agreement, the IBM 360/91 at Princeton—a private institution—was added to the capabilities of the newly established statewide utility.

The network received further impetus for development in August, 1970, when it received a grant from the National Science Foundation and matching funds from the Department of Higher Education (DHE).

[37] John A. Clark, "A Coordinating Agency and Educational Computing, The New Jersey Department of Higher Education: The First Five Years," in *Statewide Computing Systems*, edited by Charles Mosmann (New York: Marcell Dekker, 1974), p. 125.

With these resources computing services were to be made available to the colleges and universities throughout the state. Thus, the nation's first truly statewide educational computer utility was created.

During the period from August, 1970, to June, 1972, the network provided services to some twenty-three different colleges and universities using hardware at Princeton and Rutgers. Yet this service resulted in many problems. Although the academic time-sharing services offered by Princeton were acceptable to users, the administrative services provided by Rutgers proved unreliable. Because the Rutgers Computer Center did not envision itself as a statewide service bureau, the staff possessed little empathy for its users. For example, once during the registration period of the state colleges, Rutgers closed down its center to move to a new location. Obviously, such experiences frustrated the state college users.

In addition, the board of ECC experienced governance problems. To guarantee that each user had a voice in network affairs, each institution was given a seat on the board. This resulted in an unwieldy, twenty-one-person governing body. Although the Board was originally conceived as a high level policy-making group and initially had many presidents as members, over time these institutional leaders resigned. The remaining board members were computer center directors who used these meetings to demonstrate their technical competence. As one respondent said, "Board meetings became technical free-for-alls." Another respondent dubbed them "a technical congress." In any case, the board became ineffective.

In summary, ECC was an important first step in statewide cooperative computing. This consortium was the first attempt to pull together a state's educational computing resources into a single network facility. Although ECC experienced problems of both operation and governance, these experiences convinced the Department of Higher Education that cooperative computing was an alternative worthy of consideration.

THE TROUBLESOME TRANSITION TO A SECOND STATEWIDE NETWORK, EIS

With NSF funding scheduled to terminate in a few months, the Department of Higher Education (DHE) focused its efforts in the spring of 1972 on continuing the operation of the network. Most parties recognized the defects in services which ECC had provided, yet the DHE felt that a newly constituted network could eliminate many of these operational problems. With increased pressure from the state

government for centralization, informal planning sessions were held between the Rutgers central administration and the Department of Higher Education to discuss the establishment of a new statewide computer utility. Substantial progress was made initially, and it appeared as if the new "XYZ Computer Corporation" would succeed ECC. This mood of cooperation was soured when the Rutgers faculty heard of the agreement, however. The tacit agreement by Rutgers to participate in a statewide utility had been made without significant input from the faculty. The Rutgers faculty rebelled, and the faculty senate threatened a vote of censure against the President if he continued to commit Rutgers to participation in XYZ. The Rutgers administration was obliged to pull out of these negotiations and the support for the XYZ computer utility disintegrated.

With NSF funding about to terminate, however, the need for a transition organization still existed. The unpleasant experiences surrounding the collapse of the XYZ computer corporation continued to influence the second series of negotiations, which began in June, 1972.

THE ESTABLISHMENT OF NEW JERSEY'S SECOND COMPUTER UTILITY

To provide a smooth transition from a subsidized organization to a user-supported organization, an interim corporation was chartered. The NSF grant supporting ECC was terminated on June 30, 1972, and with little discussion or agreement by the parties which it affected, the Educational Information Services Corporation (EIS) was chartered in July, 1972.

With the formation of EIS, Rutgers requested that the assumptions of cooperative computing be reviewed. In response, Chancellor Dungan appointed a "Special Task Force on Computers in Higher Education" and charged it with a number of responsibilities: 1) to determine the present status and future needs of computing in New Jersey; 2) to evaluate the desirability of a central computer utility owning, operating, and controlling a major portion of the computing power available to New Jersey higher education; and 3) to suggest means for monitoring, planning, and managing computer developments. In essence, the major charge was to resubstantiate the original principal of centralized facilities or to provide suitable alternatives.

The Department of Higher Education wanted the Task Force to be a blue ribbon committee, composed of "substantial" people. Also, the committee should not be dominated by Rutgers. The final thirteen

member committee consisted of three representatives from the State Colleges, three from Rutgers, six from industry/consulting organizations, and one staff member from the Department of Higher Education.

In many ways, the Task Force was hamstrung by the limited nature of the available alternatives. As the termination of the NSF contract approached, a number of alternative means for providing cooperative computing services were suggested: 1) let ECC go on as it was constituted but with increased state funding; 2) let Rutgers become the primary source of computing, run its own shop, and sell services to other institutions; 3) have the Department of Higher Education create a single centralized EDP Division; and 4) create a new computing organization. By the time the Task Force met, however, the XYZ affair had cast doubts on the ability to create a consolidated service facility or to deprive Rutgers of ownership and control of a significant portion of its computing. Also, EIS had been incorporated as an interim transition organization. Moreover, the state government in Trenton and the Department of Higher Education were not anxious to see Rutgers become the sole vendor. Thus, the real alternative came down to a question of how EIS would be constituted, capitalized, and governed to provide educational networking.

The resulting plan produced by the Task Force reflected two major objectives: 1) to overcome the shortcomings of ECC by providing the network with ownership of its hardware, more extensive control over its services and improved governance; and 2) to accommodate Rutgers, thereby averting the prospect that the Rutgers representatives might write a minority report.

In the spring of 1973 the Task Force report was considered and approved by the Board of Higher Education. EIS then undertook the chore of implementing the computer plan by choosing a director, professional staff, and the computing configuration necessary to fulfill its mandate of providing computing services to the educational institutions of New Jersey.

THE OPERATIONAL HISTORY OF EIS

During 1973 and 1974, EIS offered a variety of computing services to the educational institutions in New Jersey. By and large, however, EIS services were utilized only by the state colleges and some county colleges; Rutgers, the Newark College of Engineering (now New Jersey Institute of Technology) and the New Jersey College of Medicine and Dentistry maintained their own facilities and were beyond the influence of the network. Although it did serve many users, the success of the network was uneven. Critics pointed out that there were deficiencies in

services; the financial structure of the network was poorly conceived; the user base provided by the state colleges was too small; and the governance and leadership of the network were poor and dominated by the Department of Higher Education. Supporters of the network argued that while many of these deficiencies were real, they could be eradicated if only the major institutions would participate to a greater degree.

Some of the poor service provided by the network was due to the choice of hardware and its operation. The network had purchased an IBM 370/158 which "front-ended" Princeton's IBM 360/91. Many months elapsed before the link-up of these two systems approached an acceptable level of stability. As a result, the system was "down" far too often and had the disagreeable habit of going down in the middle of an administrative run for one of the state colleges or other users of the network. Moreover, just as at Rutgers, the Princeton computing center tended to give preference to its own users. In one instance when its 360/91 was down, Princeton ran its own payroll on the network's computer, thus depriving network users of access to their own facility. Although such actions actually may not have happened weekly or even monthly, they lodged in the minds of users and created a genuine fear of domination by the large universities.

Although the Task Force had spoken to the issue of funding, the network was always undercapitalized. It never had adequate developmental funding from the Department of Higher Education or the users of the services. Although state and county colleges were using more and more computing power, their needs were not growing rapidly enough to provide adequate income for the network to support its own operation.

All of these problems were complicated by the level of commitment demonstrated toward EIS by various constituencies *within* the Rutgers community. On the one hand, Rutgers' academic computing facility was operated effectively and satisfied the research and instructional needs of its campuses. Rutgers' administrative computing center, however, was in need of a hardware upgrade and did not offer effective service. Thus EIS was viewed by the Rutgers administration as a vehicle for acquiring needed equipment. Second, the Rutgers administration occasionally had provided EIS with the necessary financial backing to overcome its cash flow problems. This support by the administration stood in stark contrast to the Rutgers' academic users who were not only satisfied with their present facilities, but were still smarting from the "XYZ affair." The Rutgers faculty were suspicious of statewide computing and felt that any merger with administrative facilities might result in a decline in academic services.

The most important controversy, however, centered on Rutgers' posture as an autonomous and independent institution. The legislation creating the Department of Higher Education had not defined precisely the type of powers which it would possess over the major state university. Rutgers, with its history of independence, was adamant in maintaining its position as an autonomous university. Computing became another arena in which the autonomy issue was contested. This situation was exacerbated by the Department of Higher Education's domination of EIS. As one interviewee said, "All power emanated from the Department of Higher Education." To observers it was evident that EIS was responsive to pressure from this state agency. Thus the entire EIS operation was suspect as an agent of the Department. This development was especially threatening to the Rutgers faculty who cherished its academic freedom and viewed any encroachment by the state as improper. Without the complete support of Rutgers, its major computing consumer and potential supplier of computing power and expertise, EIS struggled against the odds.

THE ESTABLISHMENT OF THE THIRD COMPUTER UTILITY

This volatile situation reached a climax in 1974 with the decision by Rutgers to purchase two new computers, a PDP-10 and an IBM 370/158. Rather than seeking the approval of the Department of Higher Education (as the Department interpreted its powers), Rutgers purchased the machines and simply notified the Chancellor's office (as Rutgers interpreted its relationship with the Department). This situation not only resulted in a heated controversy, but it also provided the catalyst for the reorganization of the troubled EIS. At this critical juncture, the newly appointed chairperson of the EIS board stepped into the fray and proposed that an ad-hoc committee determine if an agreement could be worked out which would accommodate the state colleges, Rutgers, and the state government.

As a result, an informal planning group was formed comprised of the presidents of Rutgers, William Patterson State College, Stockton State College, and the chairperson of the EIS board. This group met throughout the autumn of 1974, guided by a number of goals: 1) to reduce the Department of Higher Education's predominant influence in the educational computing network; 2) to bring Rutgers fully into the network; 3) to provide for a network that would maintain the current level and rate of development of computing at Rutgers and also permit the continuing development of computing at state colleges; 4) to "bail Rutgers out" of the IBM 370/158 affair; and 5) to create a governing

structure that would be dominated by the largest users. Although it might appear that most of these goals were to Rutgers' advantage, Rutgers was willing to make some sacrifices. Full entry into the network meant ceding Rutgers-owned computers to the network, an unpopular event on the campus. Rutgers also would be called upon to transfer some of its staff to the new network organization.

Rutgers, however, was not the only educational institution with reservations. Many individuals in the state colleges were fearful of having Rutgers dominate the network. The unpleasant experiences with the administration of computing services by both Rutgers and Princeton led many users in the state colleges to conclude that they would not receive effective service from a new, Rutgers-dominated network. Each of the state colleges had its own IBM 1130, in addition to the hardware available through the network, and they were anxious to build up their own capabilities, partly as a hedge against possible poor service from the network. Also, the state colleges were sensitive to the fact that Rutgers might be allowed to keep a significant portion of its computing personnel, while the state colleges would be unable to have such significant, in-house support for their own facilities. But the presidents of the state colleges also realized that a healthy network including Rutgers would enable them to make strides forward which they could never hope to accomplish alone or through the present EIS structure.

In November, 1974, a mutually agreeable proposal was worked out between the participants in this informal planning process. In December the proposal was presented to the Board of Directors of EIS and to the Department of Higher Education. On December 23, 1974, the members of the EIS corporation met to revise the statutes of their organization, and on January 25, 1975, EIS was officially renamed the New Jersey Educational Computing Network (ECN). The state of New Jersey had its third educational computer utility.

THE THIRD NEW JERSEY NETWORK: NJECN

The organization of this newest statewide network seeks to overcome the difficulties which its predecessors experienced. Rutgers has become a full and active partner in the organization. In return, the hardware center of the network is located on the Rutgers campus. The governance system has been changed and the financial structure of the network has been overhauled.

This new computer utility has a thirteen member governing board selected from its user groups. Twelve members are voting members and their representation is tied to their financial pledges and usage patterns.

The Department of Higher Education is the thirteenth and only non-voting member of the board. During the first sixteen months of NJECN's operation, Rutgers representatives occupied six of the twelve voting positions on the Board. After June 30, 1976, the "principals" of ECN (Rutgers, the College of Medicine and Dentistry, and the state colleges) pledge a dollar amount at the beginning of the fiscal year to cover operational costs. The number of directors which each system can appoint is then determined by the percentage which the system's pledge represents of the total amount pledged.

Although the hardware center of the network is located at Rutgers, all operations are being handled by ECN. On July 1, 1975 twelve people from the Rutgers systems and operations staff were merged with the network, resulting in a total staff of sixty-five personnel. The Rutgers academic machine (IBM 370/158) was transferred to ECN, and in August 1975 it was linked to a new IBM 370/168. The IBM 370/135, formerly the Rutgers administrative machine, has been phased out. Princeton no longer provides any services to the network. Thus all hardware operations have returned to the Rutgers campus.

At the time of this case study, ECN was a relatively new organization with a future that is difficult to predict. The compromises which have been made are obvious. The many different constituencies of Rutgers each have a significant voice in network affairs through a variety of user committees. Some of the potential problems of the new network are ones that previous New Jersey utilities have faced. For example, operations will be centered on the Rutgers campus and influenced by the former systems staff of Rutgers. The challenge to the network is to have the ECN staff view itself as a statewide service bureau and not a group servicing primarily the Rutgers campus. Without this, the same difficulties which occurred in 1970-72 could emerge again.

Second, the financial structure of this new organization remains a question mark. Although a pledge system may be a vast improvement over EIS funding arrangements, in this time of tightening budgets it would not be surprising if these institutions find other on-campus uses for their dollars. It is encouraging to note that "1976 Annual Report of NJECN" indicates that the network reduced its operational losses from $149,208 in 1975 to $18,733 in 1976. This marks significant progress in the goal of making the network financially viable.

Finally, the few Rutgers faculty whom we interviewed (March, 1975) did not look favorably on the statewide network. The NJECN center offers Rutgers faculty few advantages over their old institutionally-run center, yet it implies many risks. If services should suffer measurably, the Rutgers faculty will be the first to object.

STRENGTHS AND WEAKNESSES OF COOPERATIVE COMPUTING IN NEW JERSEY: A SUMMARY

The respondents who were interviewed in New Jersey highlighted four major strengths of cooperative computing. First, the establishment of ECN marked a new beginning for statewide computing in New Jersey. Many view this opportunity optimistically and see it as a chance to establish at long last a viable statewide network. For perhaps the first time, cooperative computing simultaneously had the backing of the state government, the Department of Higher Education, and the educational institutions.

Second, these cooperative computing ventures have created new communication links between institutions. Because of EIS/ECN meetings, institutions are more cognizant of common problems and each others' resources. With the joining together of Rutgers and the state colleges, these linkages can translate into a more unified position on educational computing, which could prove advantageous in approaching the state government on future computing issues.

Third, cooperative computing has resulted in the acquisition of more sophisticated hardware. With the economies of scale inherent in establishing centralized facilities, institutions—particularly Rutgers—have increased the hardware available to them.

Finally, state colleges have witnessed an increase in academic services available to them. As a result, some state colleges have developed computer science and data processing majors. Professors now have the academic resources necessary to assist them in their research and instruction. The state colleges view this as a strength of cooperative computing.

The weaknesses of these cooperative organizations fall into four general groupings. First, the financial problems of EIS were referenced frequently. EIS was undercapitalized, and the many resulting problems diverted the energies of network management away from operational issues. It is hoped that the new structure and procedures of ECN have eliminated those problems.

A second major shortcoming was the protracted conflict centering on Rutgers and its involvement in the network. One person mentioned that the state colleges are apprehensive about "returning" to the Rutgers campus for their computing power, given their previous experiences. This past conflict no doubt will continue to influence the development of ECN, particularly in its first years of operation.

Third, the EIS staff mentioned the difficulty of operating a computer utility when you do not control "your own destiny." It is difficult, they say, to develop good services when one does not control

one's own operations. This refers not only to their experiences with Princeton but reflects an abiding concern about their new interface with Rutgers.

Finally, both the users and the staff cited the instability of computing services as a weakness of EIS. They recognized that down time resulted in a troublesome environment and created negative attitudes about the computing utility which may be difficult to overcome.

Cooperative computing in New Jersey has a long and fascinating history which has been marked by conflict, gradual evolution, and upgrading of services. While each step has witnessed gradual improvement of cooperative services, progress has been slow. ECN represents the latest attempt to make this concept work.

THE CHRONOLOGY OF COOPERATIVE COMPUTING IN NEW JERSEY

Fall, 1968	Board of Higher Education charges Chancellor with investigating feasibility of establishing a computer network.
1969	Chancellor appoints a Computer Network Study Committee.
August, 1969	"Memorandum of Agreement" drawn up which establishes the New Jersey Educational Computer Center, Inc. (ECC).
August, 1970	NSF Grant received for the development of ECC.
Spring, 1972	Formation of "XYZ Computing Consortium" discussed by DHE and Rutgers.
	Faculty of Rutgers threaten censure of their president, Bloustein.
	XYZ Consortium collapses.
June, 1972	NSF Grant terminated.
July, 1972	Educational Information Services, Inc. (EIS) was incorporated as transition computing consortium.
	Blue ribbon committee appointed by Chancellor to re-examine the assumptions of sharing and to recommend in detail some alternatives.
Fall, 1972	Decision made to rent IBM 370/158 and have Princeton facility manage it.
Fall, 1973–Summer, 1975	EIS provides computing services from Princeton's shop via 370/158 interfaced with PU's 360/90.
Sept., 1974	Three college presidents form ad-hoc planning committee to design a new computer utility.
Nov., 1974	Ad-hoc planning group produces a proposal entitled "Outline for the Rutgers-State Colleges Proposal for a Computer Utility."
Jan., 1975	EIS is officially renamed the New Jersey Educational Computer Network (NJECN).
June, 1975	Princeton facility management contract terminated. IBM 370/158 at Rutgers becomes ECN's machine.

(continued)

The Chronology of Cooperative Computing in New Jersey (cont'd)

August, 1975	An IBM 370/168 is purchased and linked with ECN's IBM 370/158.
Jan., 1976	Phase out of the IBM 370/135 is completed.

The Evolution of Cooperative Computing in Illinois

Postsecondary education in Illinois differs from most other states by virtue of its size and organizational complexity. The state's fifty public colleges and universities are divided into five quasi-independent educational systems: University of Illinois, Southern Illinois University, Regency Universities, Board of Governors Universities, and the community college system. Each system has its own governing board which in turn reports to the state Board of Higher Education. The Board of Higher Education proposes long range plans and budgets for post-secondary education and has statutory authority to approve new degree programs. These organizational characteristics have influenced the evolution of cooperative computing in Illinois.

To date, Illinois has established three cooperative computing organizations: the Illinois Educational Consortium (IEC—formerly IECCS), the Mid-Illinois Computing Cooperative (MICC), and the Cooperative Computer Center (CCC). IEC is an "umbrella organization" which encompasses all systems of postsecondary education. MICC is a regional center whose membership cuts across governing systems and includes institutions from the Regents, Governors and SIU systems. CCC is a regional center in the Chicago area, whose total membership consists of three of the five institutions from within the Board of Governors system.

Each of these cooperative organizations was established at different times and for quite different reasons. They have evolved in response to varying mixtures of financial and political pressures and the services which they offer have yet to attain their full potential.

THE EVENTS PRECEDING STATEWIDE COMPUTER PLANNING

As with many other states, the impetus to generate a statewide educational computer plan began in the late 1960's. In a draft of its Master Plan III, the Board of Higher Education called for the establishment of a committee to consider the need for and the feasibility of establishing cooperative computing networks in the state. In the spring of 1971, the state government centralized all its non-educational computing facilities in the newly created Management Information Division. During the same period, the House of Representatives considered a bill (HR 2372) which provided for the inclusion of all

computing in higher education in this new centralized Management Information Division. Had that bill become law, all public colleges and universities would have received their computing resources through this state government agency. While the bill ultimately was tabled, its consideration demonstrated the substantial latent interest in cooperative computing.

These strong overtures at the state level were given additional impetus by the establishment of Illinois' first cooperative computing center, the CCC. At the time of CCC's conception, the recently opened Governors State University had no computing resources and Chicago State University needed a hardware upgrade. Both the Board of Higher Education and the Board of Governors recognized this dual need as a natural opportunity to establish a cooperative center that would avoid cost duplication. Thus, in 1970 the Cooperative Computing Consortium was established at Chicago State University to service three Board of Governors institutions in the Chicago area: CSU, Governor's State University, and Northeastern Illinois University.

THE DEVELOPMENT OF A STATEWIDE COMPUTING PLAN

In the summer of 1971 following the release of Master Plan III, the Board of Higher Education established an ad-hoc organization consisting of three subcommittees to begin work on a statewide computing plan. This "tri-committee" structure proved to be cumbersome and made little progress. Hence in August, 1971, a five-person Task Force for Statewide Computer Plan Development was appointed. This committee was comprised of two BHE staff members, the Deputy Director of the state's Department of Finance, and two external consultants. This particular grouping of individuals was very productive; and by November, 1971, a first draft of the statewide plan was circulated to the educational systems for their reaction. The plan proposed the

> Creation of a public interest corporation to provide general computer services to public senior institutions, and to provide, as needed and desired by the institutions, the same services to private institutions and to the community colleges.[38]

One month later the first reactions to the draft came from the Joint Council of Higher Education, a voluntary association of the presidents

[38] The Statewide Plan for Computer Resources in Illinois Higher Education, p. 176.

of all senior[39] institutions in the state. The Joint Council endorsed the notion of a public interest corporation and also supported the general recommendation of the Task Force that "the major initial impetus and direction . . . should come from the public senior institutions."[40] The presidents elaborated, however, to say that the *senior institutions* "should predominate in the control and direction of whatever cooperative organization or arrangements might prove to be feasible for the realization of the objectives identified."[41] The Joint Council also recommended that the first priority for action should be the centralized acquisition of hardware which would result in decreased costs.

The Council also outlined in its response a series of activities and a timetable for the remainder of the year. The Council proposed that membership of the public interest corporation include the public senior institutions; that two task forces be formed to continue detailed planning; that the members of the proposed consortium begin meeting on an informal yet regular basis; and that the first chairman of the consortium be the president of the University of Illinois. This strong and detailed response by the Joint Council influenced the development of the consortium, for each of these recommendations was implemented.

In January, 1972, eight months before its official establishment, the consortium informally held its first meeting. At the same time, the Task Force for Statewide Computer Plan Development collected the reactions to its initial draft. In February, 1972, it orally presented its final recommendations to the Board of Higher Education. This was followed by a printed copy on April 17, 1972. The final plan was an amalgam of the recommendations made by the Joint Council and the Task Force.

After the initial meeting of the consortium in January, this informal organization continued to push ahead with the plans outlined by the Joint Council. A temporary staff person from the University of Illinois was assigned administrative responsibilities for this consortium. The President of the University of Illinois appointed two task forces to continue detailed planning. The first task force, known as Task Force A, was to design the *organizational structure* for the consortium. Task Force B was to develop *operational plans* for the interinstitutional sharing of computer resources and services. The memberships and experiences of those two committees proved to be vastly different.

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[39] "Senior" institutions in Illinois refers to baccalaureate and graduate institutions.

[40] Joint Council memo 1/4/72 in *The Statewide Plan for Computer Resources in Illinois Higher Education*, p. 188.

[41] Ibid., p. 188.

Task Force A, since it was to focus on organizational design, was comprised entirely of executive officers from the senior institutions. Given the possibility that the state government would assume operation of campus computing, this group of chief policymakers was able to reach agreement on the establishment of a not-for-profit corporation to oversee computing services. This independent legal body would have equal representation from all senior systems and would not be operated by any single institution. Task Force A also recommended that the Department of Higher Education, private institutions, and community colleges not be represented as voting members of this organization but instead be given seats as observers. A pragmatic reason was given for not including these three groups. The senior institutions had the authority to act unilaterally while membership by the other three constituencies would necessitate a change in law, and thus significantly delaying the establishment of the statewide computing consortium. In May, 1972, Task Force A concluded its business with a recommended organizational structure, articles of incorporation, and a set of by-laws.

Task Force B, because its responsibilities were viewed as primarily technical, was composed entirely of directors of institutional computing centers. Experience showed this group to possess the technical expertise to construct a reasonable plan; however, these individuals had little experience in making broad policy decisions, and this shortcoming was to prove decisive.

Members of Task Force B were invited to submit proposals for the technological configuration of state computing. Five distinct plans were proposed, and each was defended by its proponents. But the committee could not reach accord on the best approach. No one would recommend a decrease for on-campus computing resources at her/his institution. As one respondent said, "No one wanted to return to the campus and say that he had approved the removal of the computer from the campus." Thus, the final report contained a summary of the advantages and disadvantages of each proposal, but no decisive action was taken.

Throughout its deliberations Task Force B had been frustrated by its inability to progress to a final decision. Members were threatened by what they perceived as a generally hostile climate at the state level. Moreover, these seemingly technical decisions required some agreement on the fundamental issues of campus autonomy and the transfer of funds between institutions. Not surprisingly, these computing center directors were not in a position to debate knowledgeably these issues. Selected quotations from the final report aptly demonstrate the frustrations Task Force B encountered:

> . . . it would be very helpful if a clear understanding could be reached that the objective of state planning has a more affirmative thrust than simply reducing the cost of university computing facilities. . . .
>
> . . . [T]he action of the original Consortium in assigning the development of a "statewide plan" to a committee of campus computer center directors suggests that university policy makers regard computer planning as a primarily technical exercise. . . .
>
> . . . [I]t is recommended that the Board of Directors of IECCS consider ways to improve the coordination between the operational planners and those responsible for campus policy.[42]

With the agreement by Task Force A on the establishment of a non-profit corporation, the final legal arrangements were made for the establishment of the Illinois Educational Consortium for Computing Services (IECCS) during the summer of 1972. In September, 1972, the Illinois Educational Consortium for Computing Services was officially incorporated to "advance the development and use of computing technology information systems in institutions of higher education as a means of improved management and more effective education."[43]

From the submission of the initial plan (November, 1971) to the eventual creation of IECCS (September, 1972) the University of Illinois took the lead in all negotiations. Its president was given direct responsibility by the Joint Council for overseeing the response to the initial plan. Both Task Forces A and B were chaired by persons from the University, and the first president of the consortium was hired from the University. Thus, it is not surprising that some of the state institutions perceived IECCS primarily as an instrument of the University of Illinois.

IECCS: ILLINOIS' FIRST STATEWIDE CONSORTIUM

Thus in September, 1972, the senior systems in the state embarked on a course of cooperative computing under the auspices of a single non-profit corporation. The organizational structure of IECCS consisted of a President and an eight-member board of directors. Each of the four educational systems had two representatives, generally the

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[42] Final Report of Task Force B, November 8, 1972, p. 10.

[43] By-Laws of Illinois Educational Consortium for Computer Services, Article I, p. 1.

system head and a president of one of the institutions. The BHE, the private colleges, and the community colleges each sent a non-voting representative to board meetings. Funding for the consortium was and continues to be provided by an annual membership fee of $15,000 which is assessed each of the four systems. These systems in turn divide this fee across their institutions. The annual membership fee guaranteed IECCS with an operating budget and a demonstrated commitment by its members.

Given the establishment of IECCS and a strong endorsement of the new philosophy of cooperative computing, a logical first step for sharing was to offer the most powerful computing resource in the state to other institutions. As an experiment, a series of remote terminals linked public state universities to the University of Illinois' powerful academic computing facility in the fall of 1972. This brokerage arrangement was intended to provide cost-effective computing services to higher education. At the same time the President of IECCS began negotiating with the University to "facility manage" its academic centers. Little progress was made in establishing this relationship, and in early 1973 the University terminated negotiations with IECCS for a facilities management contract. At approximately the same time, the remote links to the University of Illinois were also terminated. From this point forward, the planning for the sharing of existing facilities continued without the involvement of the state's major university and computing resources.

Immediately following the collapse of the facility management negotiations, the president of IECCS and the Board of Higher Education moved to have a task force appointed which would discuss future cooperative activities. This working committee, which came to be known as Task Force A' ("A-prime"), consisted of representatives from four mid-Illinois universities who had overlapping computing needs: Western Illinois University, Illinois State University, Sangamon State University, and Eastern Illinois University.

Task Force A' quickly reached two important decisions. First, the committee agreed to limit its focus to instructional-research computing. Second, the concept of "sub-consortia" (underneath the structure of IECCS) was discussed and approved. Within two meetings this group had agreed on its focus and approved the concept of sharing computing resources. Yet most institutions, particularly those observing these negotiations from without, felt that these efforts were merely idle chatter. Discussions about location and type of cooperative center could easily be dismissed, for the difficult process of getting institutions actually to commit themselves had not taken place.

The chemistry of the situation was altered radically when the Board of Higher Education indicated that it might be willing to award a special grant for the establishment of a regional computing center. The parties that had been involved became more serious in their negotiations, and one institution quickly changed its status from observer to participant. It was not surprising that this money acted as a catalyst causing institutions to debate seriously the policy and operational issues of establishing a cooperative center. After considerable discussion it was agreed that this new regional computer center would be located on the SIU-Edwardsville campus. In this way the Mid-Illinois Computing Cooperative (MICC) began to take shape as more than simply an idea.

As with many interinstitutional ventures, MICC needed a legal agent. IECCS, the statewide consortium, was able to step into the breach and offer itself as a legal "home" for the regional consortium. By doing this, MICC remained under the umbrella of the statewide computing organization and provided an important, visible accomplishment for IECCS.

After the lag of a budget cycle, MICC received its grant from the Board of Higher Education in the summer of 1974. At the same time bids were requested for MICC's new hardware. In January, 1975, a Cyber-72 was delivered to the SIU-Edwardsville campus; and in February MICC hired its first executive director. In February, 1975, five mid-Illinois universities began receiving instructional computing services from this regional consortium.

MICC established its own governing board consisting of ten directors, two from each member institution—the computer center director and an institutional administrator. A user advisory committee has been established to coordinate campus usage, and a MICC newsletter is being published. At the time of this data collection, potential users were optimistic about the future of MICC. Also, there was little doubt that state officials associated with education are watching this cooperative venture to determine if such an interinstitutional arrangement can meet both the needs of institutions and the state government.

While the previous discussion has traced the establishment of the statewide computing consortium and the regional centers, these are not the only significant cooperative activities that took place over this three and one-half year period. Using its leverage to attain certain economies of scale, IECCS has acted as a joint purchasing agent for state universities in acquiring computer software, training aids, computer terminals, and support equipment where common needs could be identified and bulk discounts could be negotiated. IECCS has also acted as an intermediary in facilitating mutually beneficial "tradeups" for hardware. The consortium accepts the older machine from the first

institution in trade for a newer machine. Then the older machine is sold or leased to a second institution. These cost-saving activities circumvent some of the leasing constraints placed on Illinois public institutions by hardware manufacturers and state government. These cost-saving activities have been significant consortium successes.

In addition to computing activities, during 1974-75 the four higher education member systems of IECCS established a program of cooperative purchasing and adopted common purchasing regulations. As a result, the Purchasing Advisory Council, consisting of the purchasing agents of all state universities, was established as an official organizational entity within IECCS.

Related to this expansion into cooperative purchasing, the articles of incorporation for IECCS were amended to reflect the broadened scope of activities. In April, 1975, the name of the consortium was changed to the Illinois Educational Consortium (IEC). The purposes were amended so that the consortium now exists "to support and advance the collective activities of institutions of higher education in the state of Illinois as a means to improved management."

In 1974, IECCS petitioned the Internal Revenue Service for approval as a tax exempt, non-profit corporation. After initial review, the IRS denied the request. Subsequent appeal upheld the decision, yet in the spring of 1976 the IRS reversed itself, and IEC became a tax exempt organization. This ruling not only allows IEC greater flexibility as a service organization but also sets an important precedent for the operation of other consortia.

The establishment of IEC represents a significant development, for cooperative *computing* now represents only one phase of the consortium's activity. Undoubtedly it is the consortium's most significant activity to date, but this may not always be the case. IEC now has the charter to expand its interinstitutional scope into any areas related to institutional management.

THE STRENGTHS AND WEAKNESSES OF IECCS/IEC: A SUMMARY

Three basic strengths of IECCS/IEC were cited. Most frequently mentioned were the benefits which have accrued to institutions as a result of the establishment of IECCS. For example, one respondent said that IECCS (and MICC) has provided a way for "have-not institutions to get a [computing] appropriation." Other respondents commented on the availability of increased services and the technical expertise which was available through IECCS and MICC. The second set of responses

centered on financial gains accruing from IECCS. The transfer of hardware and the lower cost for the bulk purchase of terminals were cited as distinct advantages of the statewide computing organization. Finally, many respondents cited the increased communication that was promoted by IECCS. Parties at different organizational levels typically had not communicated with each other. The broadening of IECCS charter demonstrated that this drawing together of systems can promote communication which the systems feel may be beneficial across a host of different areas, not simply computing.

The weaknesses of IECCS grouped into two broad categories. Many respondents cited the inability of IECCS to enforce a decision. People recognize that this organization had no teeth in its decision-making and that in fact each of the systems must approve a decision before it could become effective. This "unanimous" decision-making is fine until there comes a time when a tough decision has to be made on which all the parties cannot reach accord. The second weakness was related to the first. Many respondents cited the lack of visible accomplishments as a primary weakness of IECCS. MICC was reported as the first visible accomplishment and great expectations have been held out for it. As one respondent said, "To date there has been mostly discussion with few hard results."

Thus people recognize the real benefits which IECCS has provided them; many of their responses also belie the mixed success which this organization had. Its history was one of reaction to the interventions and pressures exerted upon it. There is little doubt that it strengthened the channels of communication between the systems. It also staved off the direct intervention of the state government into educational computing. The involvement of policy-makers such as presidents and system heads allowed IECCS to consider carefully the political environment and respond appropriately. *Once* a decision was made by IECCS and now by IEC there is little doubt that both systems and institutions have the commitment of system leadership.

Since the time these interviews were conducted, IEC has developed as an organization. It has evolved into the major fiscal agent for educational computing. Today the consortium is a large buyer of hardware for educational computing which it in turn leases to member institutions. MICC has added the three members of the CCC to its users as well as SIU at Carbondale. While MICC is providing instructional and research services, CCC is concentrating on developing administrative computing services.

IEC is a service organization which derives its strength from its members. The influential position and inter-system structure of IECCS has provided a rational forum for planning the growth of educational computing in Illinois.

THE CHRONOLOGY OF COOPERATIVE COMPUTING IN ILLINOIS

1970	Draft of Master Plan III (MP III) for higher education was released. It called for the establishment of a Computer Based Resources Advisory Committee (CBRAC) to consider the need and feasibility of establishing computer networks.
June 1, 1971	BHE approved progress report by its staff outlining statewide computing plan. Called for the creation of a detailed plan by December 7, 1971, and placed a moratorium on additional expenditures until the plan was completed.
Nov., 1971	The Cooperative Computing Center was officially established on the Chicago State University campus.
Nov. 23, 1971	Task Force for Statewide Computer Plan Development submitted its draft plan.
Dec., 1971	The Joint Council on Higher Education, composed of presidents of all public universities, formed an interim consortium which responded to the Task Force Report.
Jan. 24, 1972	Task Force on Organization and Mission (Task Force A) of the Illinois Universities Consortium for Computer Services created to consider the organizational structure for sharing. Task Force on Interinstitutional Cooperation in Computer Services (Task Force B) created to consider nature of sharing.
April 17, 1972	BHE published final report of Task Force for Statewide Computer Plan Development entitled, "The Statewide Plan for Computing Resources in Illinois Higher Education."
Sept., 1972	Illinois Educational Consortium for Computing Services (IECCS) was formed. Community colleges, private institutions, and the BHE were non-voting members.
Fall, 1972	Attempts were made to work out arrangements whereby the University of Illinois' computing facilities would be available on a "facilities management" basis to the consortium. These efforts failed.

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The Chronology of Cooperative Computing in Illinois (cont'd)

Feb., 1973	Task Force A' formed to investigate means of providing instructional time sharing.
Summer, 1973	BHE said they would put dollars into instructional time sharing proposal for a regional cooperative center. This increased the interest of many institutions that had been aloof to sharing.
	Task Force A' met to consider means of providing time sharing.
March, 1974	IECCS approved MICC concept and agreed to act as legal agent.
Summer, 1974	MICC received grant from the state through IECCS.
Fall, 1974	Purchasing Advisory Council, comprised of purchasing agents from all IECCS member institutions, was formed for the purpose of negotiating joint purchase agreements and volume discounts on all types of items, not just computer-related products.
Jan., 1975	MICC computer delivered to Edwardsville site. MICC began providing computing services shortly thereafter.
Spring, 1975	Request by IECCS to become a tax-exempt educational organization was denied by IRS.
April, 1975	Consortium charter was amended to include under its scope the "improvement of the management of educational institutions through collective activities." The consortium changed its name to the Illinois Educational Consortium (IEC).
Summer, 1976	IRS revised its previous position and approved IEC as a tax exempt organization.

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